Gravity Sewer and Water Main Rehabilitation and/or Replacement, Phase 1

Preliminary Design Report

TWA Project No. 16-060

PRESENTED TO

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1.0 EXECUTIVE SUMMARY

1.1 INTRODUCTION

The Toho Water Authority (TWA) initiated a program to rehabilitate and/or replace existing wastewater gravity sewer mains and water mains found to be in poor condition.

As part of the gravity sewer main effort, TWA has been performing CCTV sewer inspections since 2012 covering a majority of their Downtown and Poinciana service areas. In total, TWA has accumulated approximately 540,000 feet of gravity main and 2,260 manhole inspections covering 21 separate pump station tributary areas. In August 2016, TWA contracted with Tetra Tech to review the inspections and provide recommendations for rehabilitation or replacement of the gravity sewers and adjacent water mains.

1.2 RECOMMENDATIONS

Recommendations provided for TWA include a combination of trenchless sewer rehabilitation and open cut replacement techniques, as well as water main replacement. The recommendations for the individual lift station areas are presented in the recommendation maps provided in Appendix A. **Table 4-1** of this report summarizes the capital costs for the recommended improvements. Each lift station area has varying amounts of each type of work to be completed. The recommendations for each area include suggestions for developing construction projects such as which areas are entirely comprised of trenchless construction, where there is open cut construction, and if there are any project sequencing constraints.

The benefits of trenchless rehabilitation of these gravity sewers include:

- Minimizing additional project design efforts needed, i.e. full survey is not required for bidding projects.
- Reducing or eliminating any excavation or pavement disruption.
- Limiting inconvenience to customers and their neighborhoods during construction.
- Cost savings compared to open cut replacement.

In areas where open cut excavation is required to complete the sewer repairs, adjacent water mains were evaluated to optimize the efficiency of the construction efforts by completing the water main replacement concurrent with the sewer work.

1.2.1 Summary of Costs

The estimated cost for the recommendations presented in this report is $28,610,000. **Table 1-1** provides a summary of the construction costs for the recommended utility improvements.

Table 1-1. TWA Improvements Cost Summary

Alternative	Construction Cost, $
Gravity Sewer Rehabilitation	$10,696,000
Gravity Sewer Replacement	$14,582,000
Water Main Replacement	$3,352,000
Total	**$28,610,000**

2.0 DESIGN REQUIREMENTS AND APPROACH

2.1 PROJECT SUMMARY

TWA has been collecting inspection data for the gravity mains and manholes in 21 select lift station subareas that total 541,085 feet of gravity main and 2,266 manholes. Approximately 83% of the Gravity Mains and 86% of the manholes have been inspected as summarized in the table below.

Table 2-1. Inspected Assets

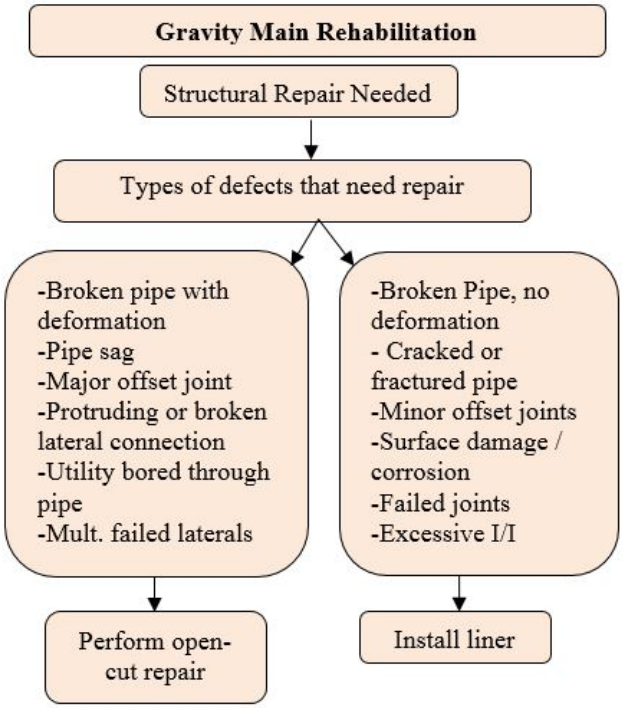
Lift Station Area	Gravity Main (ft)	% Inspected	Manholes	% Inspected
LS # 14 SAN REMO EAST	17,813	100%	81	100%
LS # 15 SAN REMO WEST	15,517	96%	72	94%
LS # 41 TROPHY LANE	10,248	99%	48	98%
LS # 42 COUNTRY CLUB ROAD	20,499	99%	82	100%
LS # 43 BOGIE	11,313	88%	52	96%
LS # 44 SCORE LANE	5,503	43%	40	77%
LS # 45 HAINES CITY ROAD	6,577	66%	31	97%
LS # 46 COYOTE ROAD	17,497	100%	68	100%
LS # 47 TIGER ROAD	31,774	94%	130	96%
LS # 54 NORTH FALCON	24,475	98%	92	97%
LS # 55 SOUTH FALCON	12,620	99%	50	96%
LS # 101 PINE ISLAND	3,784	100%	16	100%
LS # 102 ADMIRAL CT	2,583	97%	8	89%
LS # 33 OSCEOLA PARK	6,508	100%	25	96%
LS # 34 K & Y	2,483	92%	15	94%
LS # 35 LAKE FRONT	90,059	73%	416	76%
LS # 36 NEPTUNE POINT	5,016	74%	24	77%
LS # 45 JOHNSON PK	17,425	99%	68	94%
LS # 53 OLD WINN DIXIE	19,139	84%	83	85%
LS # 55 HIGHLAND PLANT	14,135	68%	69	70%
LS # 57 MARTIN ST	113,754	79%	483	83%
Total	448,722	83%	1,953	86%

There were segments of gravity mains in each area that were considered out of scope as these segments had previously been rehabilitated or were included in current TWA projects. Inspections were not provided by TWA for these segments. In other cases, pipes that were under water or manholes on sewers that were not accessible were also not inspected by TWA. A brief discussion of the general locations of these pipes and manholes is found in the summary findings for each lift station area.

2.2 APPROACH

Tetra Tech reviewed all gravity sewers that included an inspection by TWA or its CCTV contractor. Sewers and manholes that did not have any defects noted were still checked for quality control purposes to ensure that the inspector or inspection software did not omit any defects. Sewer inspection defect scoring was reviewed but was not used as a filtering mechanism for the review. NASSCO notes that "Condition Grading System alone is inadequate for determining if a pipe segment should be rehabilitated or replaced". Since different types of sewer defects can lead to different consequences in sewers of various size and materials, Tetra Tech developed a set of benchmarks for guiding staff to select the appropriate recommendation. The initial recommendations were then reviewed by senior Tetra Tech staff prior to making final recommendations. Rehabilitation recommendations were made for any defects that are identified as a failed asset or an asset that is progressively failing. A failed or failing asset indicates that a pipe or manhole could potentially lose its ability to operate as designed and could cause additional impacts to the system. A summary of the process guide is presented below with a more detailed description of the guide provided in Appendix B.

Gravity Mains



Sewer lining, also known as "Cured in Place Pipe" (CIPP), is the most common type of trenchless sewer rehabilitation for mains 8 to 15 inches in diameter. However, not all defects can be repaired through lining. The guide above identifies potential types of defects that need to be reviewed prior to making a recommendation. In many cases a segment of gravity main may be considered an ideal candidate for lining, but one or two defects that cannot be repaired using trenchless methods may be present. When this situation arises, the most cost effective option is evaluated, which may be a combination of several small open cut spot repairs (typically less than 20 feet long) and a spot liner or full length replacement. Typically, if there is more than one spot repair or more than two service laterals that need to be excavated on a segment of sewer that would otherwise be lined, it becomes more cost effective to replace the entire segment.

This approach is also used to ensure that the best long-term repair solutions are applied. While most trenchless repair products and processes have good estimated design life expectancies, when multiple repair methods are combined the quality of the overall product may be reduced.

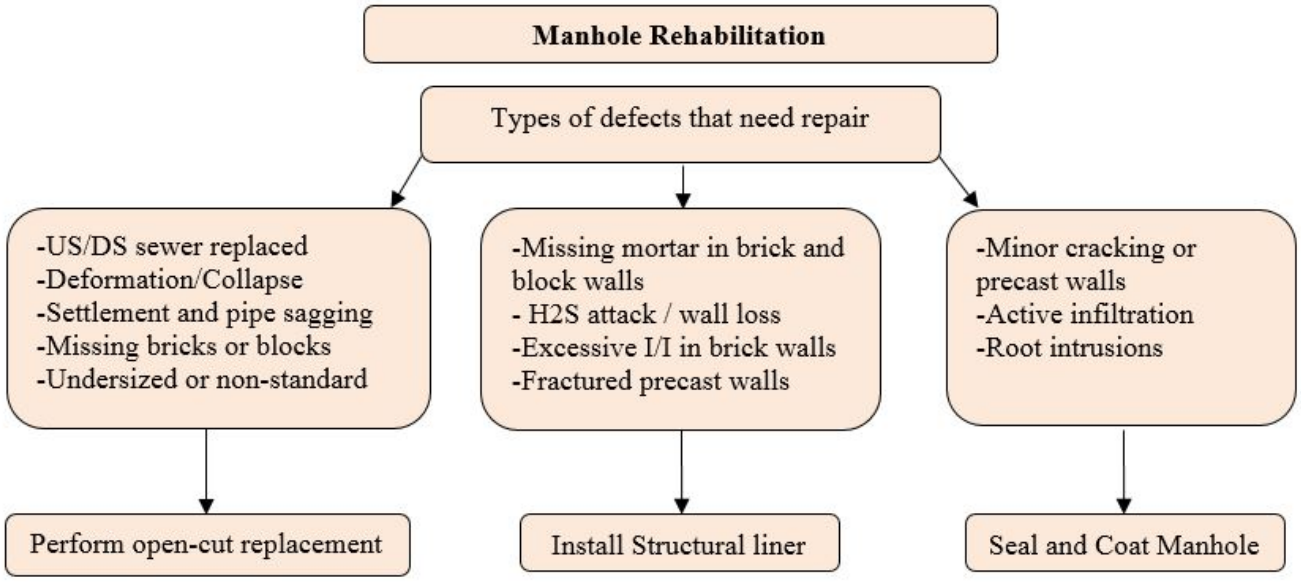
Manholes

Manhole recommendations are different from sewer recommendations as sewer defects are typically more critical to system operation than manhole defects. Satisfactory operation in a sewer gravity system is uninterrupted, unobstructed flow. Manholes are located along the gravity sewer to provide access for the maintenance of the sewers. To consider a manhole as failing, there would have to be defects that show the manhole as structurally failing and at risk of collapse. This includes older brick or CMU block manholes with fractured wall missing mortar and missing bricks or precast concrete manholes with exposed and corroded steel reinforcement.

Some manholes may need to be replaced in order to correct grade problems with the sewer. For example, manholes that were replaced on existing VCP sewers experienced settlement and subsequently caused problems with sagging pipe into and out of these structures. The only corrective action to completely solve the problem is to replace the settled manhole prior to completing the sewer rehabilitation. Sometimes manholes found along a sewer to be replaced are found to be in fair to good condition, however, replacement is recommended to facilitate the open cut replacement of the gravity main.

Manholes with structurally-threatening defects such as brick manholes with missing mortar or excessive infiltration, or precast concrete manholes with apparent H2S corrosion and wall material loss are recommended to be lined. A lining recommendation for a manhole indicates that a structural rehabilitation needs to be completed on the manhole.

Manholes with excessive infiltration, root intrusions, or minor cracking should be sealed to prevent the continued infiltration which can progress into more significant structural and settlement issues. The seal and coat item was designated so that these manholes receive some type of coating to prevent infiltration and include work to seal the manhole to stop leaks. These manholes are considered a lower priority due to the lower consequence of allowing these types of defects to remain for a period of time. Below is a summary of the manhole decision guide used for this project. A more detailed description of the guide is included in Appendix B



There are a handful of more uncommon work items that were initially categorized under the heading “Other” to capture unique work that did not fit with the standard work recommendations. These included defects such as broken drop connections, missing benches, and failed lateral liners that were categorized using the “Other” designation to initiate that a more thorough review would be required for those segments. The actual work to be completed was then used for cost estimation purposes.

All of the final recommendations were reviewed for feasibility, cost effectiveness and whether the recommendation considered the adjacent recommendations to avoid complications during construction.

Water Mains

The sewer and manhole recommendations were plotted in GIS and the adjacent water mains were evaluated in areas where the sewers needed to be replaced by open cut installation. Each lift station area was analyzed for water main replacement within the limits of the proposed sewer replacement. Approximately 50,185 feet of water main was flagged for review along the 45,753 feet of sewer recommended for replacement. The difference in quantity is due to the length of GIS shapes for water mains and the 60 foot buffer used for pipe replacement to ensure that adjacent water mains were captured in the open cut areas.

Existing assessment information was not available for the water mains. Water mains were flagged for replacement if found to be a non-standard size of less than 6-inches in diameter or of galvanized steel or asbestos cement material. In order to be conservative, mains with “Unknown” coded materials were included for replacement. Water mains with no diameter listed or a default 999 code were also included for replacement. Water mains 6 inches in diameter and greater made of CI, DI or PVC were not included for replacement.

2.2.1 Cost Estimation

Using the recommendations from the inspection reviews, a list of potential work items was developed for each lift station area. These work items were then compared with a list of current and recently used construction bid items used by TWA to confirm that the proposed work would be covered under the specifications. Specifications were then modified to ensure that all potential work items were covered in the costs developed for the project.

Recent project bid tabs were compiled for the items that were identified for the various lift station areas and developed into unit prices to use for cost estimates. The unit prices were adjusted for the current year and where the measurement and payment terms for a given pay item were modified. These unit prices were used to estimate bare construction costs for each lift station area. The bare construction costs are presented in each of the lift station areas summaries in Section 3. These bare costs only represent the direct work items involved in the recommended repairs. The individual lift station bare construction costs are shown and broken down for the work that falls under the following categories: trenchless sewer and manhole rehabilitation, open cut sewer and manhole repair or replacement, and water main replacement.

The bare costs were calculated to provide a simplified cost for the sewer and water main work by construction type so that the lift station areas could be evaluated for potential construction projects. However, there are typically additional costs involved in an actual construction project. These costs have been included in the cost summary in Section 4 of this report and include, but are not limited to, the following: Mobilization and demobilization, project general conditions, soil erosion control measures, bypass pumping and potential conflicts that are not yet identified. A 10% amount has been added to cover mobilization and demobilization. The remaining items are included the contingency assigned to each work type as follows:

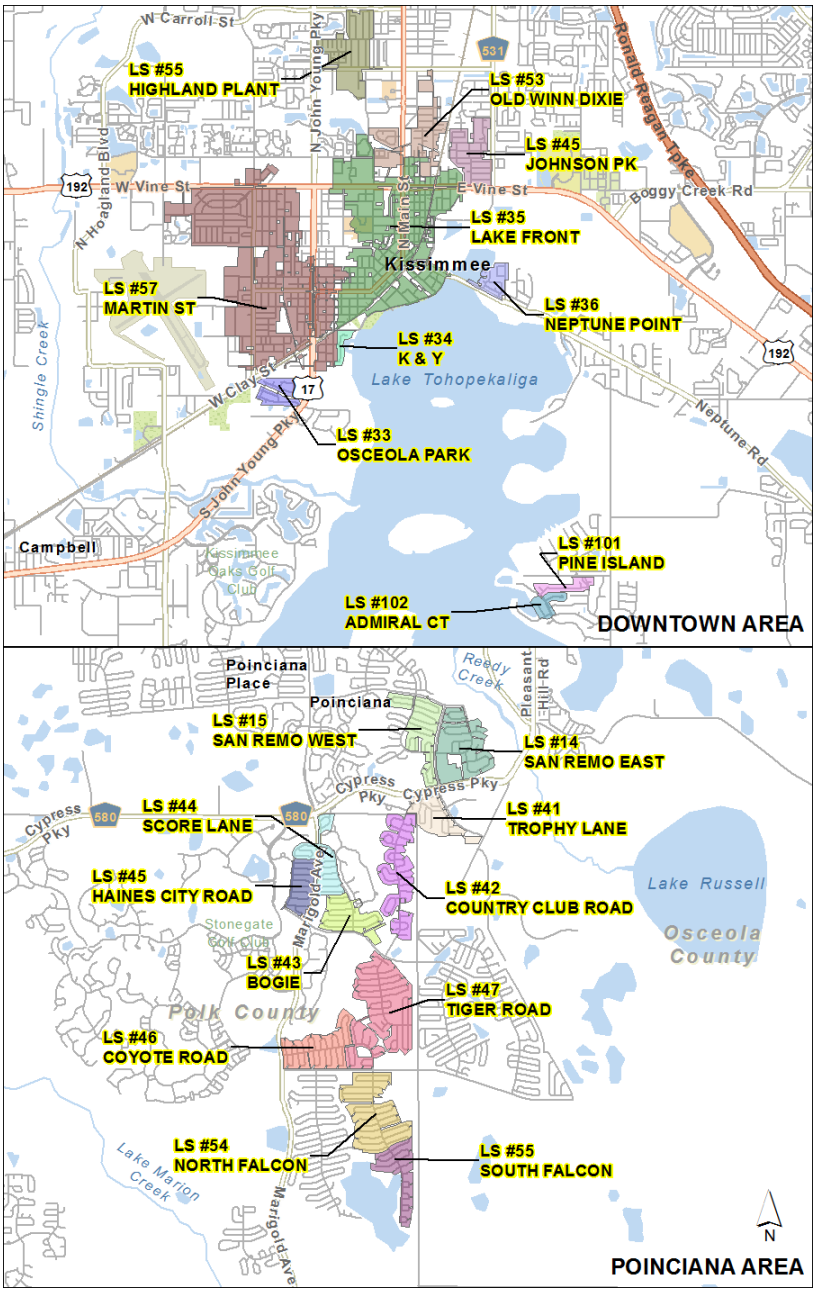
- 20% for Trenchless Repair Work – This work has very limited excavation and a lower possibility for unforeseen conditions to impact the project costs.
- 35% for Open Cut Sewer and Water Main Replacement Work – There is a higher risk of ancillary work requiring completion as part of an open cut sewer or water main replacement and repair project so a higher contingency was assigned for these improvements.

3.0 GRAVITY MAIN AND MANHOLE EVALUATIONS

3.1 LIFT STATION AREA SUMMARIES

Of the 21 pump station tributary areas that were evaluated, 10 areas were located in downtown Kissimmee and 11 areas were located in the Poinciana area. The following sections summarize the detailed evaluations for each lift station area; the gravity main, manhole and water main recommendations; and estimated bare costs. **Figure 3.1** shows the overall project area and the individual lift station project areas.

Figure 3-1. Project Areas



3.1.1 LS # 14 San Remo East

3.1.1.1 Recommendation Summary

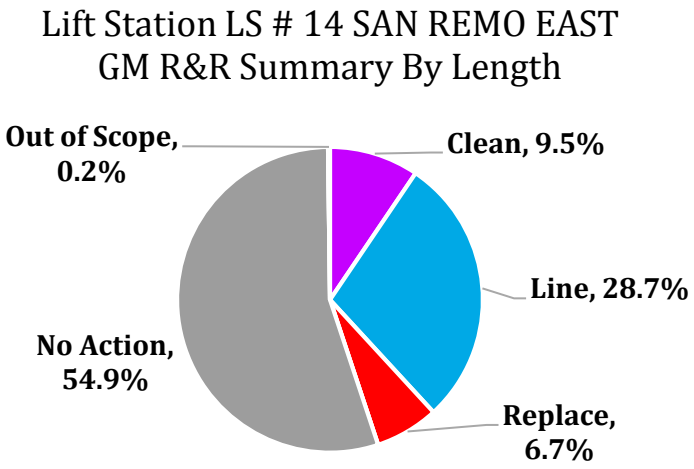
Gravity Mains

The sewer system north of San Remo Road is older than the area to the south in San Remo East area. In the northern half, the pipe is predominantly VCP sewer, while the southern half of the area consists of all PVC pipe. The VCP pipe exhibits a lot of cracking at the joints and continuous infiltration. However, lateral wye connections appear to be in good condition, making the sewers good candidates for lining.

One segment of sewer along San Remo Road has multiple full pipe sags that will require replacement of the sewer.

A total of 17 spot repairs are needed to replace some severely offset pipe connections at what appears to have been multiple manholes that settled after construction. It was common to have VCP sewers in fair condition that have 30-50% pipe offsets at the flexible connections to the PVC piping connecting to these manholes. In cases where the offset was severe, the repair will require the replacement of these manholes to correct the grade issues.

The chart below summarizes the recommendations for sewers in this area.

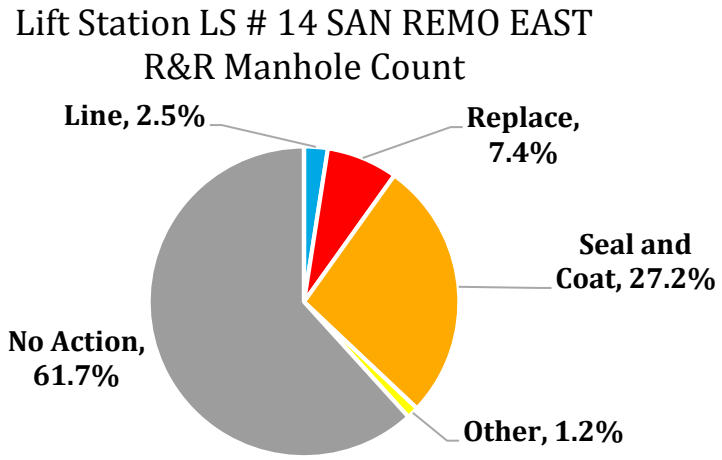


Manholes

The manholes in the southern half of the area are precast concrete construction and in generally good condition.

The manholes in the northern half of the area consist of CMU blocks. These manholes are in good structural condition but exhibit active infiltration and are recommended to be sealed and coated. These manholes appear to have a chimney seal installed in the recent past, solving infiltration problems at the top of the manhole. All recommendations for these manholes relate to addressing problems further down the MH wall.

The chart below summarizes the recommendations for the manholes in this area.



Out of Scope Assets

Inspection reports and videos were not provided for 37 feet (0.2%) of the sewers. All of the manholes in the area were inspected.. This sewer was immediately upstream of the lift station. Based on the types of defects seen upstream, it is recommended to complete the inspection, or if work is proposed on upstream sewers assume this pipe may require similar rehabilitation as those immediately adjacent.

Water Mains

There is one segment of 8-inch diameter water main impacted by sewer replacement. This main has no material designation and is assumed to be replaced with the sewer replacement construction.

Construction Considerations

This lift station area has mostly trenchless rehabilitation and could be bid as a trenchless construction project.

Preliminary Construction Costs

Estimated bare construction costs to complete the rehabilitation recommended above are presented in the table below.

DESCRIPTION	ESTIMATED QUANTITIES	UNIT	UNIT PRICE ($)	COST ($)
Medium Cleaning Sanitary Sewer Mains (8" to 12" Diameter)	1,690	LF	$2.00	$3,380.00
Sanitary Sewer Main 8” Diameter (8' to 10' Depth)	1,204	LF	$65.00	$78,260.00
Sanitary Manholes 4’ Diameter (8' to 10' Depth)	6	EA	$5,400.00	$32,400.00
Seal and Recoat Manhole (48" Diameter)	198	VF	$300.00	$59,400.00
Fiberglass Manhole Insert (48" Diameter)	2	EA	$6,500.00	$13,000.00
Install/Repair/Replace Sanitary Sewer Lateral (10' to 15' Depth @ main)	24	EA	$2,610.00	$62,640.00
Sanitary Sewer Main CIPP Liner (8" Diameter)	5,053	LF	$40.00	$202,120.00
Sanitary Sewer Main CIPP Liner (10" Diameter)	69	LF	$45.00	$3,105.00
FCLRL – CIPP Lateral Liner (6" Diameter, ≤30 LF)	5	EA	$2,745.00	$13,725.00
Sanitary Sewer Main Point Repair (6' to 10' Depth) (0 to10 feet long) (Incl. Road Rest.)	6	EA	$10,000.00	$60,000.00
Sanitary Sewer Main Point Repair (10' to 15' Depth) (0 to 20 feet long) (Incl. Rd. Rest.)	3	EA	$15,000.00	$45,000.00
CIPP point repair, 8" Diameter Sanitary Sewer Main	3	EA	$4,500.00	$13,500.00
Milling and Resurfacing	1,605	SY	$11.00	$17,655.00
Asphalt Roadway Replacement (2"to 4" thick w/base)	1,338	SY	$45.00	$60,210.00
Water Main w/fittings & RJs (8" Diameter)	1,204	LF	$28.00	$33,712.00
Gate Valve with Box (8" Diameter)	4	EA	$1,450.00	$5,800.00
Fire Hydrant Assembly	2	EA	$3,230.00	$6,460.00
Water Service (short side)	13	EA	$650.00	$8,450.00
Water Service (long side)	13	EA	$1,125.00	$14,625.00
				$ 733,500.00

Estimated Trenchless Lining Construction Cost = $413,300

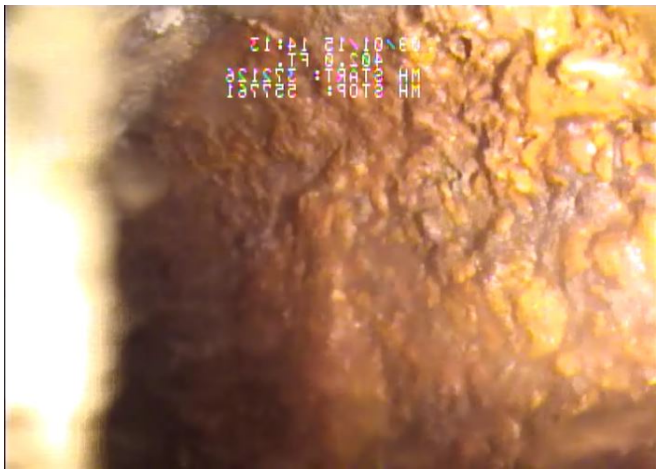
Estimated Open Cut Sewer Construction Cost = $251,200

Estimated Water Main Replacement Cost = $69,100

3.1.1.2 Significant Snapshots:

Several snapshots of defects found in the area are presented below.

Offset MMC



DIP Wall Scale

Full Pipe Sag

CL in VCP

3.1.2 LS # 15 San Remo West

3.1.2.1 Recommendation Summary

Gravity Mains

The gravity main piping in San Remo West is primarily VCP with segments of PVC pipe in Americana Court, south of San Remo Road, and the first 5 reaches of sewer heading north out of the lift station.

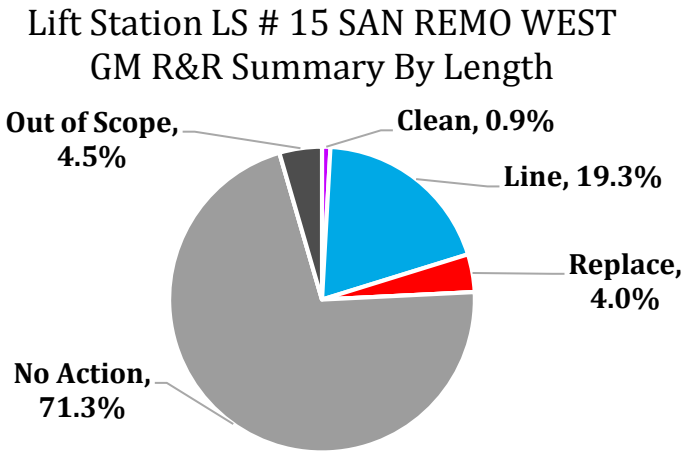
The PVC pipe is in very good condition, however, there are some lateral issues along several reaches that will require some rehabilitation. The VCP pipe exhibits significant cracking at the joints and continuous infiltration such that 16 reaches are recommended for lining, with two of those mains needing spot repairs to correct pipe sagging before the remaining portion of the sewer is lined.

The VCP sewers in this area have a high number of failing service connections that were visible from the mainline inspections. The connection defects appear to originate along the laterals upstream of the main and are identified by large blockages caused by infiltration of groundwater and soil. It is recommended that these service connections be verified as active, then lined to correct the defects.

Three pipe segments are recommended to be replaced, including two upstream mains, with little overall system impact. The other sewer to be replaced, which crosses San Remo Road at Madeira Court, has several full pipe sags.

A total of 24 spot repairs have been identified, with 19 of these spot repairs being service laterals that are recommended for lining. A handful of spot repairs should be completed prior to lining to correct defects such as short sags, protruding service connections or severely offset joints.

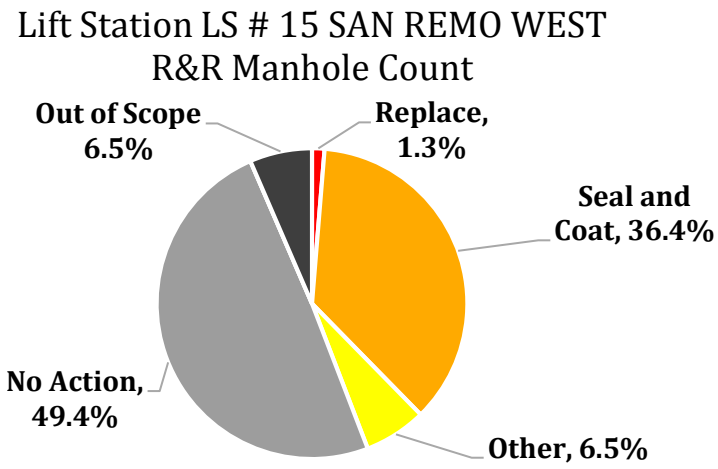
The chart below summarizes the recommendations for sewers in this area.



Manholes

All of the manholes on VCP sewers are brick, with just a few precast concrete manholes. The brick manholes are in good structural condition but exhibit active infiltration and are recommended to be sealed and coated.

The chart below summarizes the recommendations for the manholes in this area.



Out of Scope Assets

Inspection reports and videos were not provided for 731 feet (4%) of the sewers and 5 (6%) of the manholes. Two of the sewer segments and manholes that were not inspected are immediately upstream of the lift station and were likely not inspected due to high water conditions. The remaining uninspected sewers are spread around the area consisting of VCP pipe. There were no apparent reasons to not obtain the manhole inspections that were missed; however, based on the findings, it is unlikely that any of the uninspected manholes require any action other than seal and coat. Considering this, it is recommended that the remaining VCP sewers and brick manholes be inspected prior to construction to identify any remaining rehabilitation work.

Water Mains

There are three sewer segments to be replaced and the water main along each segment did not have a material designation, so it is assumed the water main will be replaced with the sewer construction. Approximately 1,000 feet of 6-inch and 10-inch water mains are included for replacement.

Construction Considerations

The pipe recommended to be replaced is found along sewer reaches that do not overlap with any of the trenchless recommendations. This would allow for the trenchless rehabilitation work to be bid as a separate project from the pipe replacement.

Preliminary Construction Costs

Estimated bare construction costs to complete the rehabilitation recommended above can be seen in the table below.

DESCRIPTION	ESTIMATED QUANTITIES	UNIT	UNIT PRICE ($)	COST ($)
Medium Cleaning Sanitary Sewer Mains (8" to 12" Diameter)	144	LF	$2.00	$288.00
Sanitary Sewer Main 8" Diameter (8' to 10' Depth)	650	LF	$65.00	$42,250.00
Sanitary Manholes 4' Diameter (8' to 10' Depth)	1	EA	$5,400.00	$5,400.00
Seal and Recoat Manhole (48" Diameter)	297	VF	$300.00	$89,100.00
Install/Repair/Replace 4" Sanitary Sewer Lateral (10' to 15' Depth @ Main)	13	EA	$2,610.00	$33,930.00
Sanitary Sewer Main CIPP Liner (8" Diameter)	2,792	LF	$40.00	$111,680.00
Sanitary Sewer Main CIPP Liner (15" Diameter)	350	LF	$55.00	$19,250.00
FCLRL – CIPP Lateral Liner (6" Diameter, ≤30 LF)	19	EA	$2,745.00	$52,155.00
Sanitary Sewer Main Point Repair (6' to 10' Depth) (0 to 10 feet long) (Incl. Road Rest.)	2	EA	$10,000.00	$20,000.00
Sanitary Sewer Main Point Repair (10' to 15' Depth) (0 to 20 feet long) (Incl. Rd. Rest.)	2	EA	$15,000.00	$30,000.00
CIPP Point Repair, 8" Dia San Sewer Main	1	EA	$4,500.00	$4,500.00
Milling and Resurfacing	867	SY	$11.00	$9,537.00
Asphalt Roadway Replacement (2" to 4" thick w/base)	722	SY	$45.00	$32,490.00
Water Main w/fittings & RJs (8" Diameter)	989	LF	$28.00	$27,692.00
Water Main w/fittings & RJs (10" Diameter)	29	LF	$30.00	$870.00
Gate Valve with Box (8" Diameter)	3	EA	$1,450.00	$4,350.00
Fire Hydrant Assembly	3	EA	$3,230.00	$9,690.00
Water Service (short side)	10	EA	$650.00	$6,500.00
Water Service (long side)	10	EA	$1,125.00	$11,250.00
				$ 511,000.00

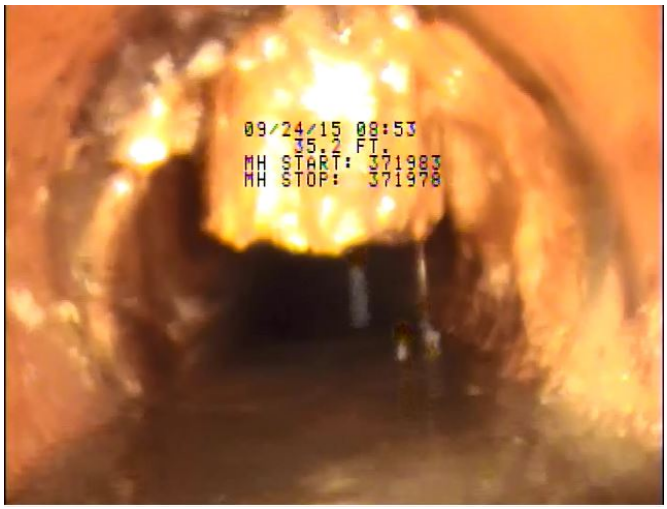
Estimated Trenchless Lining Construction Cost = $327,000

Estimated Open Cut Sewer Construction Cost = $123,600

Estimated Water Main Replacement Cost = $60,400

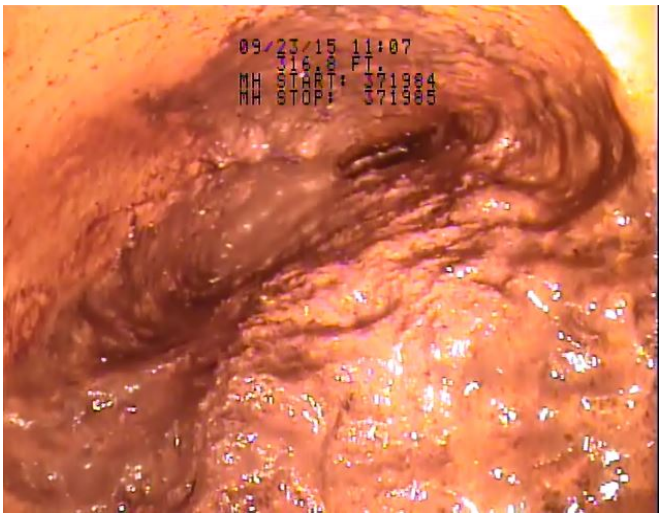
3.1.2.2 Significant Snapshots:

Several snapshots of defects found in the area are presented below.



Protruding Lateral and Broken Main

Plugged Active Lateral



Lateral Sealed Shut with Scale

Cracked MH Chimney

3.1.3 LS # 41 Trophy Lane

3.1.3.1 Recommendation Summary

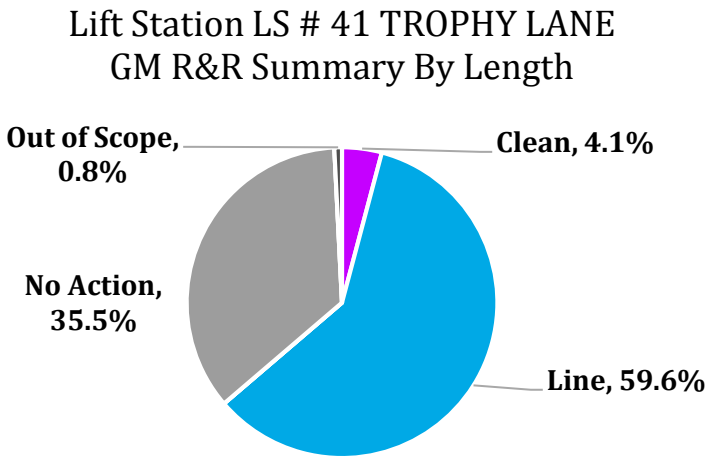
Gravity Mains

The gravity main piping in Trophy Lane is VCP. Several segments have already been lined in the past. The previously lined sewers are spread throughout the area and do not suggest any pattern of failure.

In general, the gravity mains are not in good condition, with widespread longitudinal pipe cracking and joint failures. The pipe is still at good line and grade, so lining is feasible for the majority of the work, with only 3 spot repairs identified in the project area.

There are 6 service laterals that exhibit defects such as cracking in the portion visible from the main, and should be lined in conjunction with gravity main rehabilitation. None of the inspected sewer reaches in this area require full replacement.

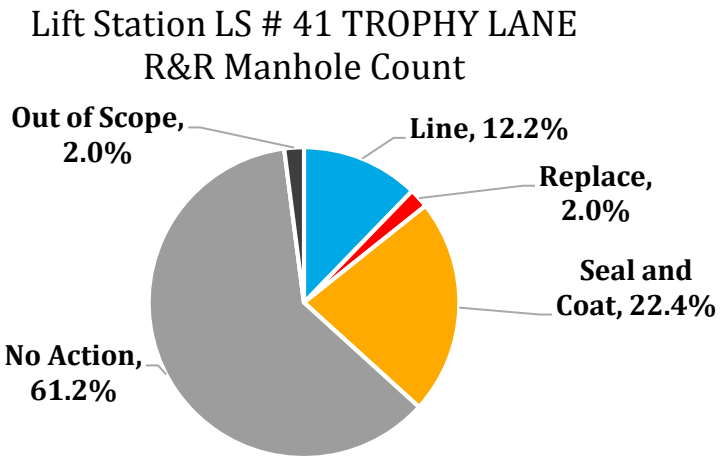
The chart below summarizes the recommendations for sewers in this area.



Manholes

All of the manholes in the area are precast concrete with brick chimneys. These manholes are in fair structural condition but some have issues with chimney failure and infiltration and are recommended to be sealed and coated. The manholes have brick benches and several were observed to be crumbling. Combined with other defects such as failing pipe connections, this resulted in full structural manhole lining recommendations.

The chart below summarizes the recommendations for the manholes in this area.



Out of Scope Assets

Inspection reports and videos were not provided for 82 feet (1%) of the sewers and 1 (2%) manhole. A pipe stub extending east in County Club Road may not have been inspected due to water level and accessibility. A lined sewer in Chip Court and the furthest upstream reach in the southeast corner of the lift station area off Flag Lane did not have inspection reports. The other uninspected assets are low-impact and unlikely to result in additional work.

Water Mains

There are no sewers being replaced in this area, therefore no water mains were included for replacement.

Construction Considerations

The manhole recommended to be replaced is on the downstream end of a sewer to be lined. Being a single manhole to be replaced, it is recommended that this work be included in the trenchless rehabilitation project.

Preliminary Construction Costs

Estimated bare construction costs to complete the rehabilitation recommended above are presented in the table below.

DESCRIPTION	ESTIMATED QUANTITIES	UNIT	UNIT PRICE ($)	COST ($)
Medium Cleaning Sanitary Sewer Mains (8" to 12" Diameter)	427	LF	$2.00	$854.00
Sanitary Manholes 4’ Diameter (8' to 10' Depth)	1	EA	$5,400.00	$5,400.00
Seal and Recoat Manhole (48" Diameter)	99	VF	$300.00	$29,700.00
Fiberglass Manhole Insert (48" Diameter)	6	EA	$6,500.00	$39,000.00
Sanitary Sewer Main CIPP Liner (8" Diameter)	6,157	LF	$40.00	$246,280.00
FCLRL – CIPP Lateral Liner (6" Diameter, ≤30 LF)	6	EA	$2,745.00	$16,470.00
Sanitary Sewer Main Point Repair (6' to 10' Depth) (0 to 10 feet long) (Incl. Road Rest.)	3	EA	$10,000.00	$30,000.00
Sanitary Sewer Main Point Repair (10' to 15' Depth) (0 to 20 feet long) (Incl. Rd. Rest.)	1	EA	$15,000.00	$15,000.00
				$ 382,800.00

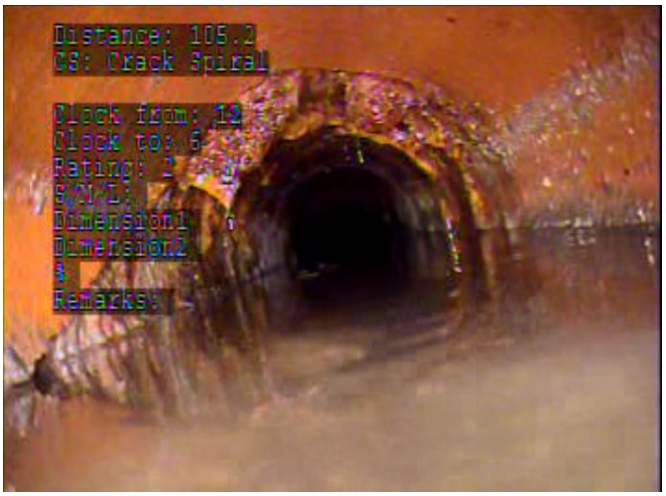
Estimated Trenchless Lining Construction Cost = $377,400

Estimated Open Cut Sewer Construction Cost = $5,400

There are no anticipated water main replacements in this area.

3.1.3.2 Significant Snapshots:

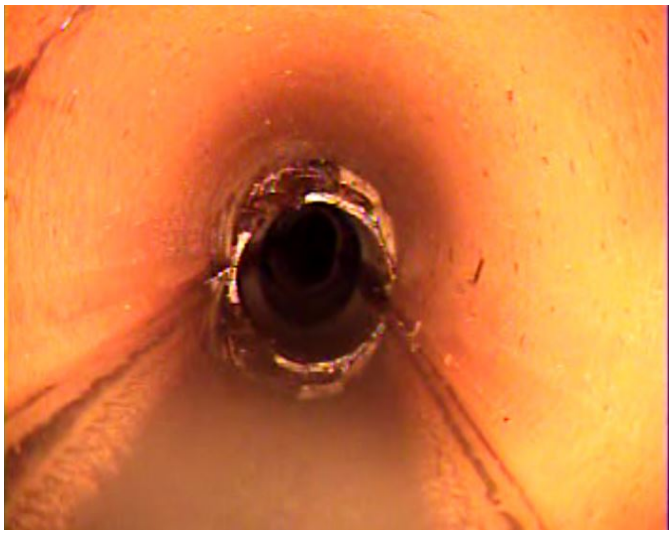
Several snapshots of defects found in the area are presented below.



Broken Main

Linear Fracturing

Grease at Crown of Pipe



Offset VCP Joint

3.1.4 LS # 42 Country Club Road

3.1.4.1 Recommendation Summary

Gravity Mains

The gravity main piping in the Country Club Road Lift Station Area is VCP, with a number of segments previously lined. The previously lined sewers are spread throughout the area and do not suggest any pattern of failure.

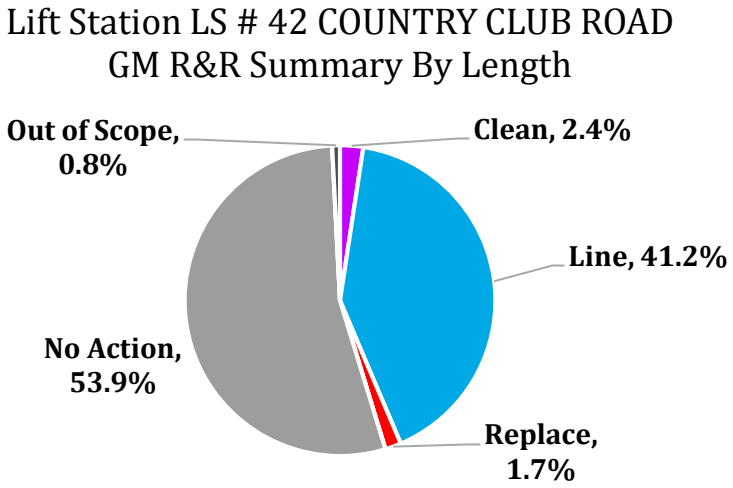
The VCP is in poor condition with widespread longitudinal pipe cracking, joint failures, and significant lateral issues. The pipe is at good line and grade, so lining is feasible for the majority of the work.

There are 6 spot repairs to correct offset connections, pulled out lateral piping and sagging mains.

There are approximately 42 service laterals that exhibited defects such as cracking in the portion visible from the main and should be lined in conjunction with the gravity main rehabilitation. Failing laterals were found in clusters located throughout the lift station area. Some previously lined sewers have laterals that now should be lined. There are several existing lateral liners on Duffer Lane that have begun to fail and should be investigated further to determine if additional rehabilitation is required.

One reach of sewer that had been previously lined has multiple full pipe sags and several liner defects and should be replaced. There is also the potential for additional pipe replacements along Country Club Road, as some of the sewers that could not be inspected may have similar defects.

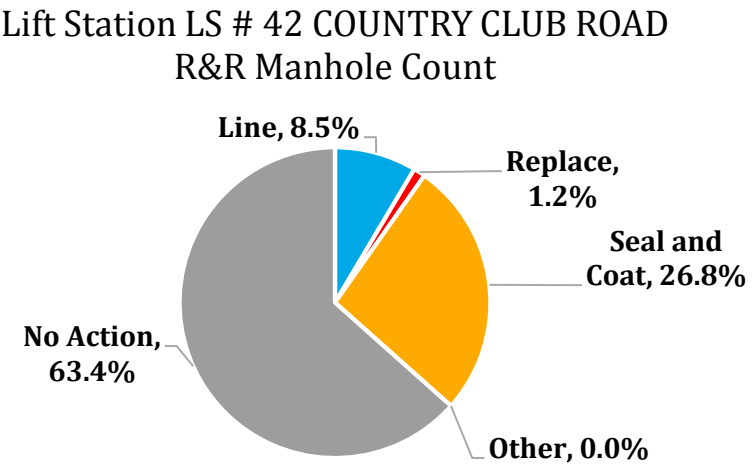
The chart below summarizes the recommendations for sewers in this area.



Manholes

All of the manholes in the area are precast concrete with brick chimneys. These manholes are in fair structural condition, but some have issues with chimney failure and infiltration and are recommended to be sealed and coated. Some of the manholes along the trunk sewer show signs of wall loss and have failing pipe connections and are recommended to be lined. The manhole recommended for replacement is an upstream terminal manhole that is beginning to fail.

The chart below summarizes the recommendations for the manholes in this area.



Out of Scope Assets

Inspection reports and videos were not provided for 167 feet (1%) of sewer and all manholes were completed. The uninspected sewer includes the first two reaches downstream of the Trophy Lane force main discharge manhole and pumped flow may have prevented access for the CCTV equipment. These sewers are submerged as noted during the manhole inspections and as shown in the photograph below. If possible, this reach of pipe should be cleaned and drained to allow for inspection so that the cause of the standing water can be identified and corrected.

MH with 1 foot+ of Standing Water

Water Mains

One sewer is being replaced in the Country Club Road lift station area. The adjacent water main is 2 inches in diameter and is included to be replaced by 335 feet of 6-inch water main.

Construction Considerations

The sewer identified for replacement is located in Green Court, which is at the upstream end of where the trunk sewer is submerged. It is likely that some of the submerged sewers may need to be replaced to correct the condition, so the recommended sewer replacements may expand. Several of the tributary sewers are noted to be rehabilitated, so it is recommended that the pipeline replacement in this lift station area be verified and completed prior to performing the lining work.

Preliminary Construction Costs

Estimated construction costs to complete the rehabilitation recommended above are presented in the table below.

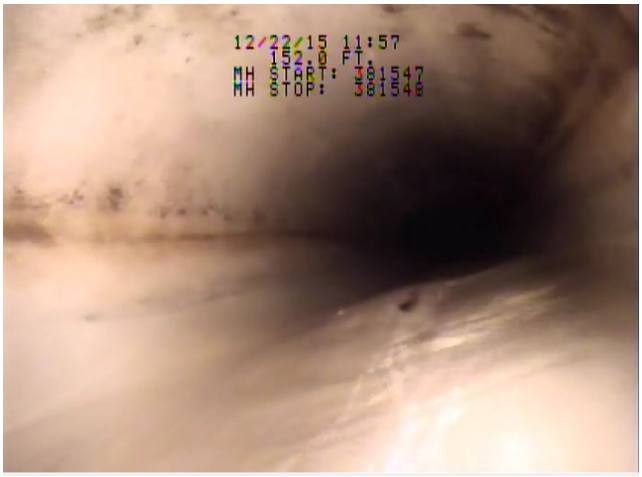
DESCRIPTION	ESTIMATED QUANTITIES	UNIT	UNIT PRICE ($)	COST ($)
Medium Cleaning Sanitary Sewer Mains (8" to 12" Diameter)	994	LF	$2.00	$1,988.00
Sanitary Sewer Main 8” Diameter (8' to 10' Depth)	346	LF	$65.00	$22,490.00
Sanitary Manholes 4’ Diameter (8' to 10' Depth)	1	EA	$5,400.00	$5,400.00
Install/Repair/Replace 4" Sanitary Sewer Lateral (10' to 15' Depth @ Main)	7	EA	$2,610.00	$18,270.00
Sanitary Sewer Main CIPP Liner (8" Diameter)	6,408	LF	$40.00	$256,320.00
Sanitary Sewer Main CIPP Liner (10" Diameter)	770	LF	$45.00	$34,650.00
Sanitary Sewer Main CIPP Liner (12" Diameter)	2,076	LF	$50.00	$103,800.00
FCLRL – CIPP Lateral Liner (6" Diameter, ≤30 LF)	40	EA	$2,745.00	$109,800.00
Sanitary Sewer Main Point Repair (6' to 10' Depth) (0 to 10 feet long) (Incl. Road Rest.)	5	EA	$10,000.00	$50,000.00
Sanitary Sewer Main Point Repair (10' to 15' Depth) (0 to 20 feet long) (Incl. Rd. Rest.)	1	EA	$15,000.00	$15,000.00
CIPP Point Repair, 8” Dia San Sewer Main	2	EA	$4,500.00	$9,000.00
Milling and Resurfacing	461	SY	$11.00	$5,071.00
Asphalt Roadway Replacement (2"to 4" thick w/base)	384	SY	$45.00	$17,280.00
Water Main w/fittings & RJs (6" Diameter)	338	LF	$26.00	$8,788.00
Gate Valve with Box (6" Diameter)	1	EA	$1,150.00	$1,150.00
Fire Hydrant Assembly	1	EA	$3,230.00	$3,230.00
Water Service (short side)	4	EA	$650.00	$2,600.00
Water Service (long side)	4	EA	$1,125.00	$4,500.00
				$ 669,400.00

Estimated Trenchless Lining Construction Cost = $580,600
Estimated Open Cut Sewer Construction Cost = $68,500
Estimated Water Main Replacement Cost = $20,300

3.1.4.2 Significant Snapshots:

Several snapshots of defects found in the area are presented below.

Gushing I/I at Broken Lateral



Buckled Liner

Failing Lateral Liner

Corroded MH Wall

Settled Wye Connection

3.1.5 LS # 43 Bogie

3.1.5.1 Recommendation Summary

Gravity Mains

The gravity main piping in the Bogie Lift Station Area west of Fairway Road is VCP. Several sewers were previously lined. The previously lined sewers are located on Bar Court, west of Fairway Road. Bar Drive, east of Fairway Road, contains PVC sewers.

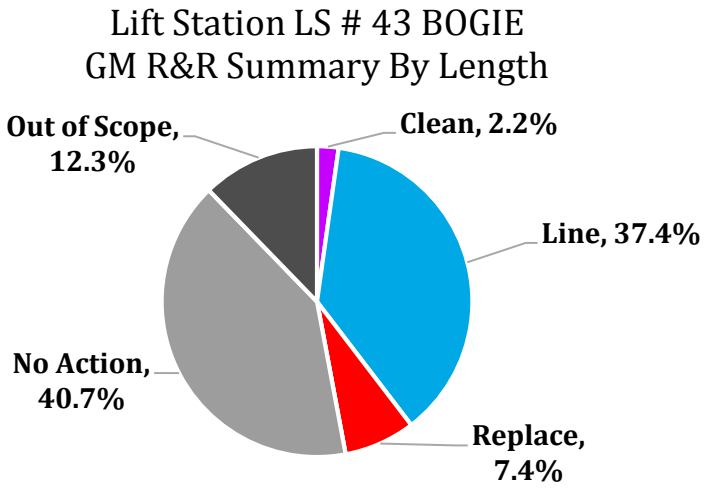
The VCP is in poor condition with widespread longitudinal pipe cracking, joint failures, and significant lateral issues. A majority of the sewers west of Fairway Road are recommended to be lined, as groundwater issues have weakened VCP joints and the pipe has begun to crack. The only defect identified along the PVC sewers was an external vertical penetration through one of the pipes.

Four spot repairs are recommended for this area, including one to remove the pipe obstruction noted above and the other three to correct pipe sags and offsets.

The service lateral connections throughout this area are in good condition, with only one requiring rehabilitation based on observations from the main line.

Three sewers have been marked for replacement. Two are adjacent VCP sewers with consistent cracking including several defects at wye connections. The second sewer to be replaced is a previously lined pipe that is fully submerged for an unknown length. Should this pipe be dewatered and fully inspected, it is possible that the sag is not severe enough to require replacement. It is the forth reach of sewer from the upstream terminal end, but there is a force main connected upstream and the sag may eventually lead to maintenance problems.

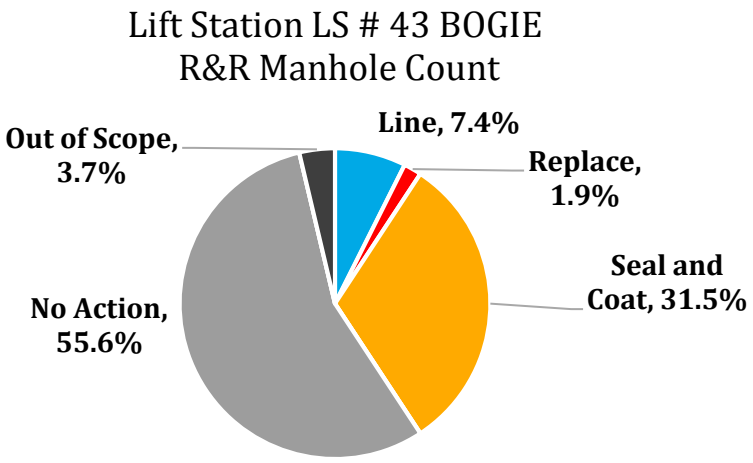
The chart below summarizes the recommendations for sewers in this area.



Manholes

All of the manholes in the area are precast concrete with brick chimneys. Approximately 17 of these manholes have failing chimneys and wall infiltration and are recommended to be sealed and coated. Four (4) manholes along the trunk sewer are showing signs of heavy corrosion and should be lined. No manholes are recommended to be replaced in this area.

The chart below summarizes the recommendations for the manholes in this area.



Out of Scope Assets

Inspection reports and videos were not provided for 1,581 feet (12%) of sewer and 2 (4%) manholes. A fair amount of the uninspected sewer includes the trunk line which is 10-inch and 12-inch pipe with high flow velocities. The CCTV equipment was likely overflowed when placed in these sewers. To inspect these sewers, the flow must be temporarily bypassed. Considering both that the trunk line is VCP and the rest of the area has a significant amount of defects, these sewers likely are in need of repair and should be inspected. The remaining portions of the trunk line in Fairway Road should be inspected before initiating a project in this area.

Water Mains

There are two sewers to be replaced in the Bogie lift station area. The adjacent water mains are 6 and 8-inch diameter of an unknown material and are included to be replaced as part of this project.

Construction Considerations

Note that the previously lined sewer may not require replacement upon full inspection. There is also a chance that some of the uninspected trunk sewer may need to be replaced. Several of the manholes recommended to be lined are located on this sewer and should be replaced if the sewer is replaced. The remaining recommended work could be bid individually with no specific sequencing suggestions. If the trunk sewer is to be replaced, some of the tributary sewers are recommended to be lined. In that scenario, the replacement project should be completed prior to the lining project.

Preliminary Construction Costs

Estimated construction costs to complete the rehabilitation recommended above can be seen in the table below.

DESCRIPTION	ESTIMATED QUANTITIES	UNIT	UNIT PRICE ($)	COST ($)
Medium Cleaning Sanitary Sewer Mains (8" to 12" diameter)	394	LF	$2.00	$788.00
Medium Cleaning Sanitary Sewer Mains (15" to 24" Diameter)	182	LF	$4.00	$728.00
Sanitary Sewer Main 8” Diameter (8' to 10' Depth)	958	LF	$65.00	$62,270.00
Sanitary Manholes 4’ Diameter (8' to 10' Depth)	1	EA	$5,400.00	$5,400.00
Install/Repair/Replace 4" Sanitary Sewer Lateral (10' to 15' Depth @ main)	19	EA	$2,610.00	$49,590.00
Seal and Recoat Manhole (48" Diameter)	170	VF	$300.00	$51,000.00
Fiberglass Manhole Insert (48" Diameter)	4	EA	$6,500.00	$26,000.00
Sanitary Sewer Main CIPP Liner (8" Diameter)	4,419	LF	$40.00	$176,760.00
Sanitary Sewer Main CIPP Liner (15" Diameter)	785	LF	$55.00	$43,175.00
Sanitary Sewer Main Point Repair (6' to 10' Depth) (0 to 10 feet long) (Incl. Road Rest.)	2	EA	$10,000.00	$20,000.00
Sanitary Sewer Main Point Repair (10' to 15' Depth) (0 to 20 feet long) (Incl. Rd. Rest.)	2	EA	$15,000.00	$30,000.00
CIPP Point Repair, 8” Dia San Sewer Main	1	EA	$4,500.00	$4,500.00
Milling and Resurfacing	1,277	SY	$11.00	$14,047.00
Asphalt Roadway Replacement (2"- 4" thick w/base)	1,064	SY	$45.00	$47,880.00
Water Main w/fittings & RJs (6" Diameter)	690	LF	$26.00	$17,940.00
Water Main w/fittings & RJs (8" Diameter)	664	LF	$28.00	$18,592.00
Gate Valve with Box (6" Diameter)	2	EA	$1,150.00	$2,300.00
Gate Valve with Box (8" Diameter)	2	EA	$1,350.00	$2,700.00
Fire Hydrant Assembly	2	EA	$3,230.00	$6,460.00
Water Service (short side)	14	EA	$650.00	$9,100.00
Water Service (long side)	14	EA	$1,125.00	$15,750.00
				$ 605,000.00

Estimated Trenchless Lining Construction Cost = $353,000

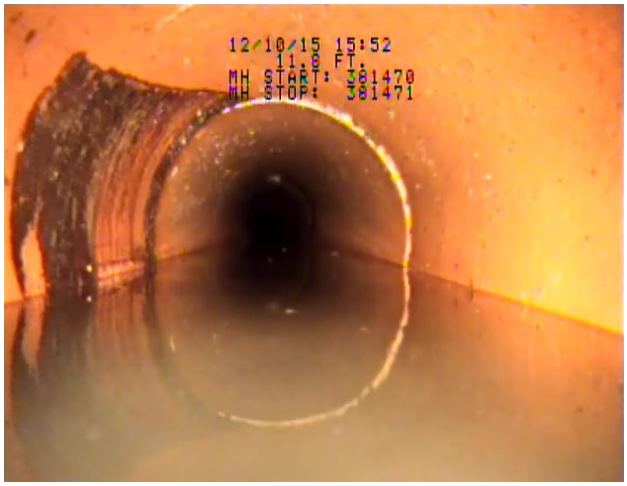
Estimated Open Cut Sewer Construction Cost = $179,200

Estimated Water Main Construction Cost = $72,800

3.1.5.2 Significant Snapshots:

Several snapshots of defects found in the area are presented below.

Fractured Pipe



Longitudinal Fracture

Pipe Obstacle

Typical Brick MH Wall Condition

Grease in Sagging Pipe

3.1.6 LS # 44 Score Lane

3.1.6.1 Recommendation Summary

Gravity Mains

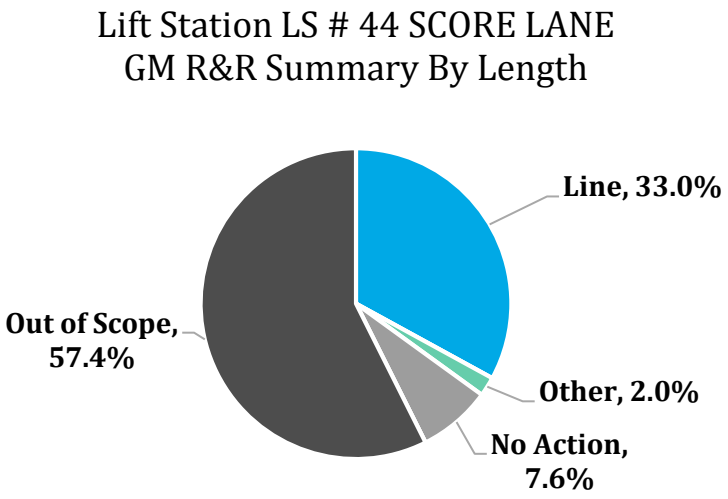
The Score Lane Lift Station Area consists essentially of two different areas separated by the lift station. Sewers south of the lift station are VCP and in fairly poor condition, with a PVC trunk sewer down Fairway Road that was not inspected. The sewers north and west of the lift station are largely uninspected aside from a handful of manholes along the main.

The VCP pipe south of the lift station is in poor condition with infiltration and root issues at the joints. All but two of these sewers were recommended for some type of lining or repair.

Two spot repairs are recommended for this area to correct pipe offsets where the tributary sewers connect to the pipes in Fairway Road.

Eleven (11) service connections are recommended to be lined, in many cases due to significant infiltration or root intrusions into the joints that is visible at the main line.

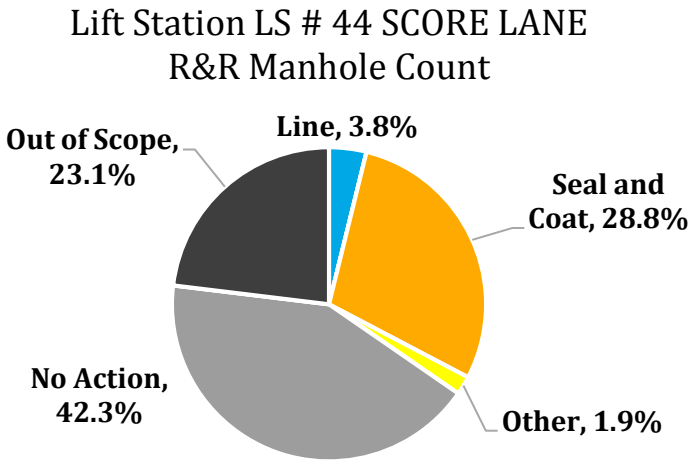
The chart below summarizes the recommendations for sewers in this area.



Manholes

All of the manholes in the area are precast concrete with brick chimneys. Approximately 15 of these manholes have failing chimneys and/or wall infiltration and are recommended to be sealed and coated. Two (2) manholes along the trunk sewer are showing signs of heavy corrosion and should be lined. No manholes are recommended to be replaced in this area. Several of the manholes along the uninspected sewer west of the lift station are in very poor condition due to corrosion and the rest of the structures are likely subjected to a similar environment.

The chart below summarizes the recommendations for the manholes in this area.



Out of Scope Assets

Inspection reports and videos were not provided for 7,410 feet (57%) of sewer and 12 (23%) manholes. The pipes along Fairway Road were not fully inspected. South of the lift station, it appears to be due to some downstream offsets holding up the water level. North and west of the lift station, the flow appears still and a number of the manholes inspected along these pipes show standing water, sometimes above the crown of the pipe. Additionally, none of the sewers and most of manholes along Prestwick Place were inspected. The few manholes that were inspected lacked flow channels and may have contributed to why inspections were not completed. We recommend that the remaining sewers in these areas be cleaned, drained and inspected prior to finalizing the recommendations for construction.

Water Mains

There are no sewers currently being replaced in this area, therefore no water mains were included for replacement.

Construction Considerations

A large amount of pipe and manholes were not inspected in this project area. It is recommended that the rest of the area be inspected and evaluated. Of the approximately 40% of sewers in the area that were inspected, there was only trenchless work, however the cause of the standing water may require some replacement, so the strategy for this area will depend on completing the inspections.

Preliminary Construction Costs

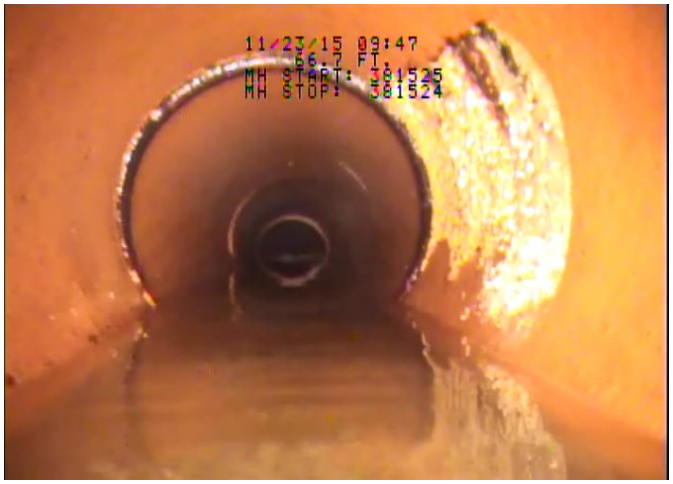
Estimated bare construction costs to complete the rehabilitation recommended above are presented in the table below.

DESCRIPTION	ESTIMATED QUANTITIES	UNIT	UNIT PRICE ($)	COST ($)
Seal and Recoat Manhole (48" Diameter)	160	VF	$300.00	$48,000.00
Fiberglass Manhole Insert (48" Diameter)	2	EA	$6,500.00	$13,000.00
Sanitary Sewer Main CIPP Liner (8" Diameter)	4,257	LF	$40.00	$170,280.00
FCLRL – CIPP Lateral Liner (6" Diameter, ≤30 LF)	10	EA	$2,745.00	$27,450.00
Sanitary Sewer Main Point Repair (6' to 10' Depth) (0 to 10 feet long) (Incl. Road Rest.)	3	EA	$10,000.00	$30,000.00
				$ 288,800.00

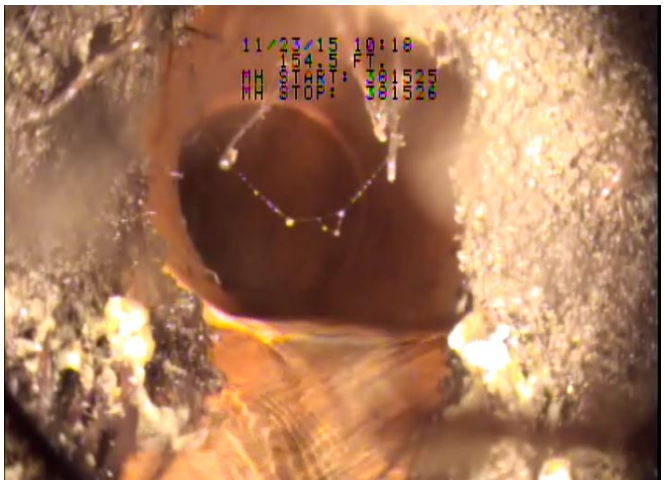
3.1.6.2 Significant Snapshots:

Several snapshots of defects found in the area are presented below.

Broken Pipe at Drop Connection



Longitudinal Fracture w I/I Stain



Defective Lateral Connection

MH on Uninspected Pipe

Offset PVC Connection to Lined Pipe

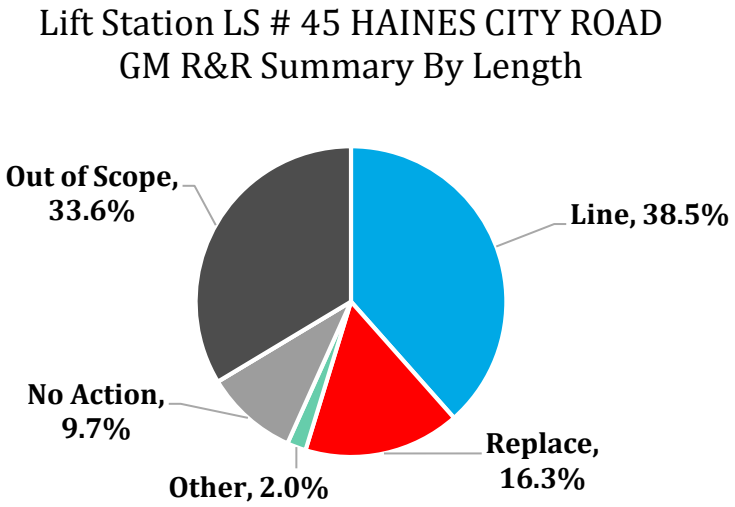
3.1.7 LS # 45 Haines City Road

3.1.7.1 Recommendation Summary

Gravity Mains

The Haines City Road Lift Station Area is a located on the opposite side of Marigold Avenue from Score Lane and has a lot of similar characteristics. The sewers are primarily VCP with some PVC reaches, however, a fair amount of the sewers were not inspected as part of the scope of this project. Thirteen (13) sewers inspected were recommended to be lined due to poor joints, minor offsets and infiltration. Two (2) service connections are recommended to be lined due to cracking and separated joints at the connection.

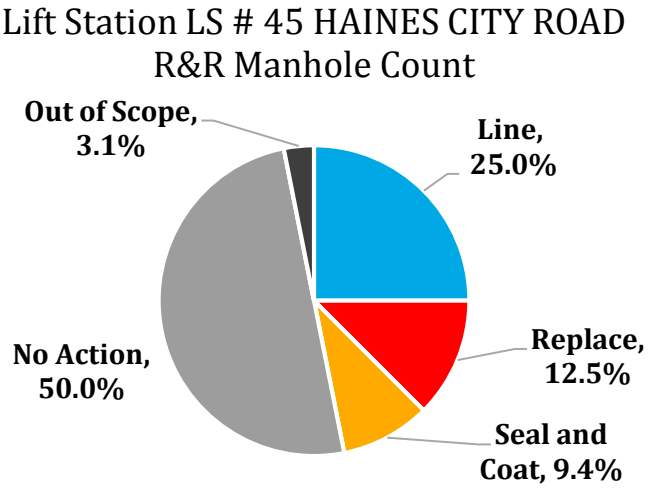
The chart below summarizes the recommendations for sewers in this area.



Manholes

All of the manholes in the area are precast concrete with brick mortared chimneys. The majority of the manholes in the area were inspected and observations confirmed that water was high and the pipes were submerged, preventing CCTV inspection of the sewers. Three (3) manholes had excessive infiltration and should be sealed and coated. Eight (8) manholes along the trunk sewer are showing signs of heavy corrosion just above the standing water line and should be lined. Four (4) manholes are recommended to be replaced in this area.

The chart below summarizes the recommendations for the manholes in this area.



Out of Scope Assets

Inspection reports and videos were not provided for 3,330 feet (34%) of sewer and 1 (3%) manhole. The pipes along Haines City Road were not fully inspected and a few of the tributary reaches of sewer were not inspected. Nearly all of the manholes in the area have been inspected. From manhole inspections, it was observed that water was standing in the manholes above the crown of the pipe, with some manholes holding as much as 3.5 feet of water. We suggest that these remaining sewers in these areas be cleaned, drained and inspected prior to finalizing the recommendations for construction.

Water Mains

There are currently no sewers recommended for replacement in this area, therefore no water mains were included for replacement.

Construction Considerations

A fair amount of pipe and manholes were not inspected in this project area. It is recommended that the rest of the area be inspected and evaluated. Only 43% of the sewers in the area were inspected, and the existing VCP sewer that was observed was found to be in poor condition and require replacement or rehabilitation.

Preliminary Construction Costs

Estimated construction costs to complete the rehabilitation recommended above are presented in the table below.

DESCRIPTION	ESTIMATED QUANTITIES	UNIT	UNIT PRICE ($)	COST ($)
Sanitary Sewer Main 8-inch Diameter (8' to 10' depth)	1,612	LF	$65.00	$104,780.00
Sanitary Manholes 4-feet Diameter (8' - 10' depth)	4	EA	$5,400.00	$21,600.00
Install/Repair/Replace 4" Sanitary Sewer Lateral (10' to 15' depth @ main)	32	EA	$2,610.00	$83,520.00
Seal and Recoat Manhole (48" diameter)	30	VF	$300.00	$9,000.00
Fiberglass Manhole Insert (48" diameter)	8	EA	$6,500.00	$52,000.00
Sanitary Sewer Main CIPP Liner (8" diameter)	3,810	LF	$40.00	$152,400.00
FCLRL – CIPP Lateral Liner (6" diameter, ≤30 LF)	2	EA	$2,745.00	$5,490.00
Milling and Resurfacing	2,149	SY	$11.00	$23,639.00
Asphalt Roadway Replacement (2"- 4" thick w/base)	1,791	SY	$45.00	$80,595.00
Water Main w/fittings & RJs (6" diameter)	1,693	LF	$26.00	$44,007.60
Gate Valve with Box (6" diameter)	5	EA	$1,150.00	$5,750.00
Fire Hydrant Assembly	5	EA	$3,230.00	$16,150.00
Water Service Connection (short side)	17	EA	$650.00	$11,050.00
Water Service Connection (long side)	17	EA	$1,125.00	$19,125.00
				$ 629,200.00

Estimated Trenchless Lining Construction Cost = $218,900

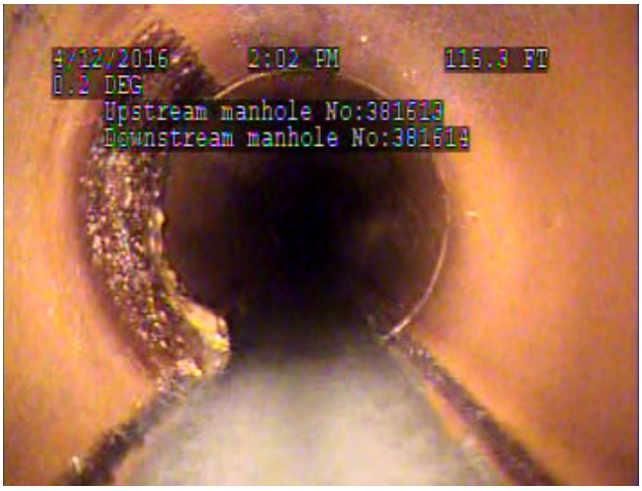
Estimated Open Cut Sewer Construction Cost = $314,200

Estimated Water Main Construction Cost = $96,100

3.1.7.2 Significant Snapshots:

Several snapshots of defects found in the area are presented below.

Offset Joint



Longitudinal Fracture

MH Wall Condition

MH on Uninspected Pipe

3.1.8 LS # 46 Coyote Road

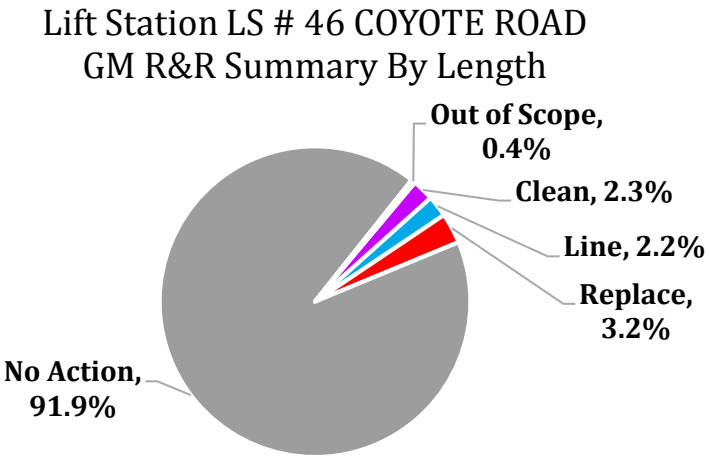
3.1.8.1 Recommendation Summary

Gravity Mains

The gravity main piping and service laterals in the Coyote Road Lift Station Area are PVC pipe. In general, the pipe is in good condition, with many sewers having some minor (10-30%) sagging that does not appear to impact the operation of the sewer. Some of the upstream terminal sewers with low flows have some dirt in the main and should be cleaned to avoid future maintenance issues.

There are a few pipes that have some segments that need to be repaired due to full pipe sagging. Three are short spot repairs to fix broken mains and service connections and to correct sagging into a manhole. Two longer sags (40 and 90 feet long) need to be replaced as the pipe is fully submerged and causing issues in the upstream sewer. There is also one crack to be repaired with a spot liner, and a cracked lateral that should be lined. The defects are spread out through the area.

The chart below summarizes the recommendations for sewers in this area.

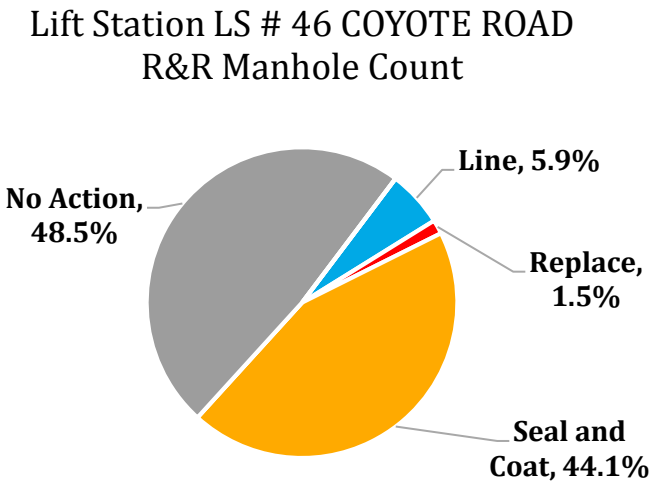


Manholes

All of the manhole in the area are precast concrete with brick chimneys. These manholes are in good structural condition, however groundwater infiltration is an issue in about half of the manholes.

The manhole inspections were completed in 2015 and showed a lot of issues with the manhole chimneys, however the sewer CCTV inspections that were completed in 2016 show that chimney seals had been installed. A handful of these seals have already failed due to the intensity of the I/I and have been noted for repair. Four (4) manholes in the area need to be lined due to some concrete degradation and include several manholes along the trunk sewer that have drop connections.

The chart below summarizes the recommendations for the manholes in this area.



Out of Scope Assets

Inspection reports and videos were provided for all but one 74 foot segment of pipe in the area that goes into the lift station due to high flows.

Water Mains

The existing water mains adjacent to the sewers proposed to be replaced are 6” in diameter and have an unknown material listed, so they are assumed to be replaced during this project.

Construction Considerations

The two pipes requiring open cut repairs have sags of 40 and 90 feet long respectively, and could be included with the trenchless repair contract in this area, or bundled with open cut repairs for some of the adjacent lift station areas. There is no overlap between assets requiring open cut and trenchless repairs, so these projects could be bid separately.

Preliminary Construction Costs

Estimated construction costs to complete the rehabilitation recommended above are presented in the table below.

DESCRIPTION	ESTIMATED QUANTITIES	UNIT	UNIT PRICE ($)	COST ($)
Medium Cleaning Sanitary Sewer Mains (8" to 12" diameter)	396	LF	$2.00	$792.00
Sanitary Sewer Main 8-inch Diameter (6' to 8' depth)	557	LF	$60.00	$33,420.00
Seal and Recoat Manhole (48" diameter)	360	VF	$300.00	$108,000.00
Fiberglass Manhole Insert (48" diameter)	4	EA	$6,500.00	$26,000.00
Install/Repair/Replace 4" Sanitary Sewer Lateral (10' to 15' depth @ main)	11	EA	$2,610.00	$28,710.00
FCLRL – CIPP Lateral Liner (6" diameter, ≤30 LF)	1	EA	$2,745.00	$2,745.00
Sanitary Sewer Main Point Repair (6' to 10' depth) (0 -10 feet long) (Incl. Road Rest.)	2	EA	$10,000.00	$20,000.00
Sanitary Sewer Main Point Repair (10' to 15' depth) (0-20 feet long) (Incl. Rd. Rest.)	2	EA	$15,000.00	$30,000.00
Asphalt Roadway Replacement (2"- 4" thick w/base)	619	SY	$45.00	$27,855.00
Water Main w/fittings & RJs (6" diameter)	585	LF	$26.00	$15,206.10
Gate Valve with Box (6" diameter)	2	EA	$1,150.00	$2,300.00
Fire Hydrant Assembly	1	EA	$3,230.00	$3,230.00
Water Service Connection (short side)	6	EA	$650.00	$3,900.00
Water Service Connection (long side)	6	EA	$1,125.00	$6,750.00
Medium Cleaning Sanitary Sewer Mains (8" to 12" diameter)	396	LF	$2.00	$792.00
				$ 317,100.00

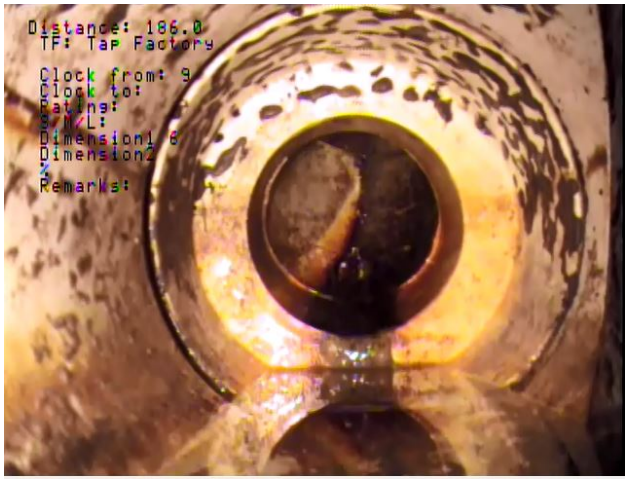
Estimated Trenchless Lining Construction Cost = $187,500

Estimated Open Cut Sewer Construction Cost = $98,200

Estimated Water Main Construction Cost = $31,400

3.1.8.2 Significant Snapshots:

Several snapshots of defects found in the area are presented below.

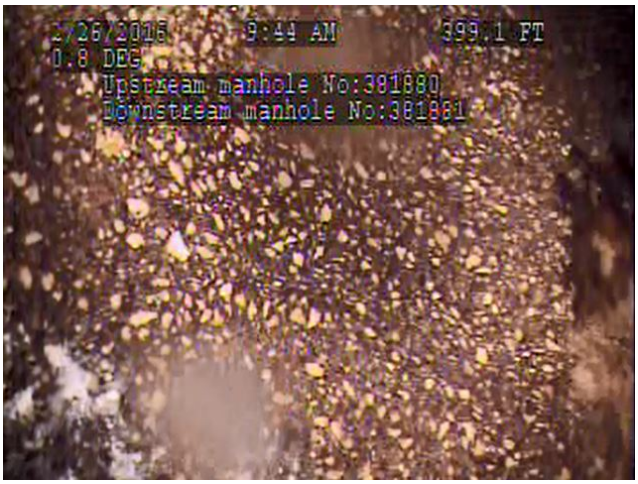


Failed Lateral

Attached Grease Going Into Sag

Leaking Chimney Seal

Significant MH I/I



Drop MH Wall Condition

3.1.9 LS # 47 Tiger Road

3.1.9.1 Recommendation Summary

Gravity Mains

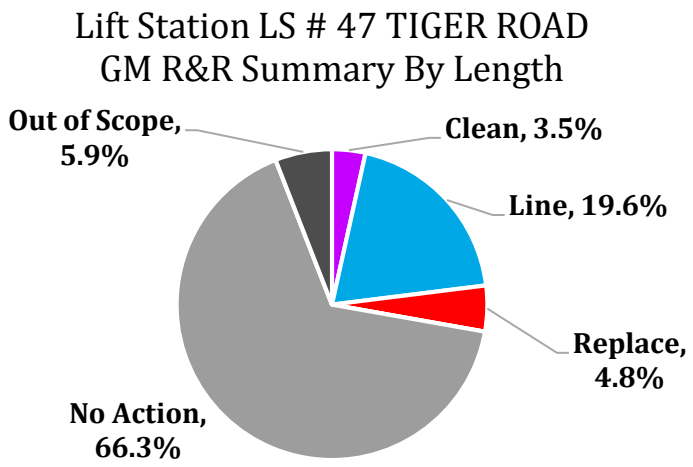
The gravity main piping in the Tiger Road Lift Station Area is VCP with most of the pipe in fair condition. However infiltration is a significant problem. The defects impacting the sewers are different for the tributary reaches and the trunk sewer.

Many of the tributary lines have poor joints and infiltration issues, leading to a number of sewers with minor (10-30%) sagging that should be lined. One common type of sag in this area is where the pipe sags into a downstream manhole. Several pipes have so many sags or have multiple severe sags and cannot be repaired by lining so these have been recommended for replacement. Despite the number of observed issues with VCP main joints, the lateral connections and piping that could be seen appeared to be in relatively good condition.

The trunk sewers on Tiger Road have continuous joint issues and active infiltration, with most of these sewers recommended for lining. Closer to the lift station, the water mark on the pipe indicated these pipes run full or submerged often and it may be prudent to verify if there are capacity issues in some of these pipes. Where the surcharging is observed, there are some issues with grease attaching to the pipe and restricting the flow.

Seven (7) spot liners have been identified to repair isolated problems such as broken joints or gushing infiltration. Five (5) lateral liners are needed to repair cracked lateral piping. There are 10 spot repairs needed and one open cut lateral repair, with almost all of these being to repair small sagging segments of a pipe that is recommended to be lined.

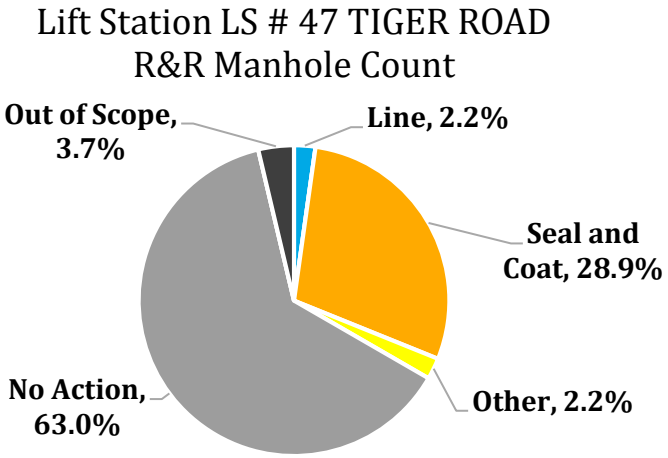
The chart below summarizes the recommendations for sewers in this area.



Manholes

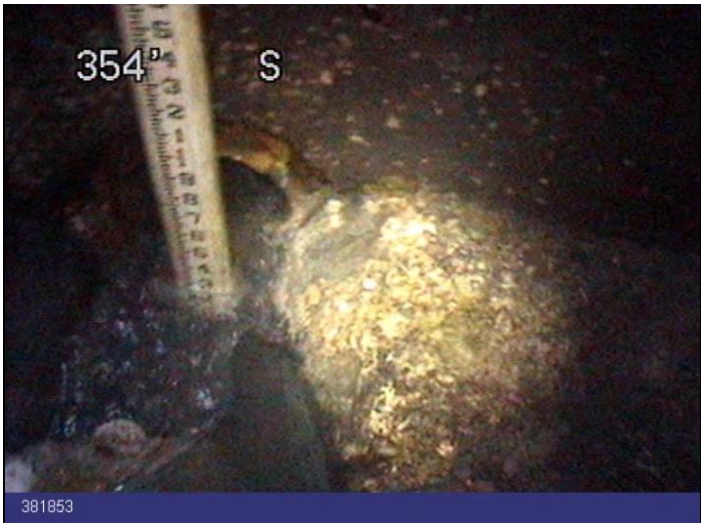
All of the manholes in the area are precast concrete with brick chimneys. Chimney seals have been installed within the last several years and are holding up well. 36 manholes were identified to be sealed and coated based on significant active infiltration on the walls. Three (3) manholes along the trunk sewer had signs of wall corrosion and should be lined.

The chart below summarizes the recommendations for the manholes in this area.



Out of Scope Assets

Inspection reports and videos were not provided for 1,998 feet (6%) of sewer and 5 (4%) manholes. The uninspected pipe line includes the trunk sewer just upstream of the lift station, including most of the sewer in Gazelle Drive and a few tributary sewers. The trunk inspected upstream had high flows and grease indicating the pipe was likely not inspected due to high water. If possible, these sewers should be cleaned and drained to allow for inspection. The photo below is from a manhole inspection along Gazelle Drive showing fast flows meaning this pipe may need to be bypassed to complete the inspection.



Water Mains

There are 4 sewers being replaced in the Tiger Road lift station area. The water mains adjacent to these sewers include both 3 and 6-inch diameter pipes of unknown material and are included for replacement.

Construction Considerations

The five (5) sewers that need to be replaced are in the tributary areas and connect at higher elevations along the trunk sewer manholes that are being lined. It is possible to issue two separate construction projects without requiring any additional coordination or sequencing provisions.

Preliminary Construction Costs

Estimated bare construction costs to complete the rehabilitation recommended above can be seen in the table below.

DESCRIPTION	ESTIMATED QUANTITIES	UNIT	UNIT PRICE ($)	COST ($)
Medium Cleaning Sanitary Sewer Mains (15" to 24" diameter)	1,172	LF	$4.00	$4,688.00
Sanitary Sewer Main 8-inch Diameter (8' to 10' depth)	1,610	LF	$65.00	$104,650.00
Sanitary Manholes 4-feet Diameter (8' - 10' depth)	4	EA	$5,400.00	$21,600.00
Install/Repair/Replace 4" Sanitary Sewer Lateral (10' to 15' depth @ main)	32	EA	$2,610.00	$83,520.00
Seal and Recoat Manhole (48" diameter)	288	VF	$300.00	$86,400.00
Fiberglass Manhole Insert (48" diameter)	3	EA	$6,500.00	$19,500.00
Re-construct Manhole Benching	1	EA	$700.00	$700.00
Replace Inside Drop Connection	1	EA	$2,000.00	$2,000.00
Sanitary Sewer Main CIPP Liner (8" diameter)	3,507	LF	$40.00	$140,280.00
Sanitary Sewer Main CIPP Liner (10" diameter)	3,096	LF	$45.00	$139,320.00
FCLRL – CIPP Lateral Liner (6" diameter, ≤30 LF)	5	EA	$2,745.00	$13,725.00
Sanitary Sewer Main Point Repair (6' to 10' depth) (0 -10 feet long) (Incl. Road Rest.)	3	EA	$10,000.00	$30,000.00
Sanitary Sewer Main Point Repair (10' to 15' depth) (0-20 feet long) (Incl. Rd. Rest.)	8	EA	$15,000.00	$120,000.00
CIPP point repair, 8" diameter sanitary sewer main	7	EA	$4,500.00	$31,500.00
Milling and Resurfacing	2,147	SY	$11.00	$23,617.00
Asphalt Roadway Replacement (2"- 4" thick w/base)	1,789	SY	$45.00	$80,505.00
Water Main w/fittings & RJs (6" diameter)	2,252	LF	$26.00	$58,552.00
Gate Valve with Box (6" diameter)	5	EA	$1,150.00	$5,750.00
Fire Hydrant Assembly	3	EA	$3,230.00	$9,690.00
Water Service Connection (short side)	23	EA	$650.00	$14,950.00
Water Service Connection (long side)	23	EA	$1,125.00	$25,875.00
				$ 1,016,900.00

Estimated Trenchless Lining Construction Cost = $588,200

Estimated Open Cut Sewer Construction Cost = $313,900

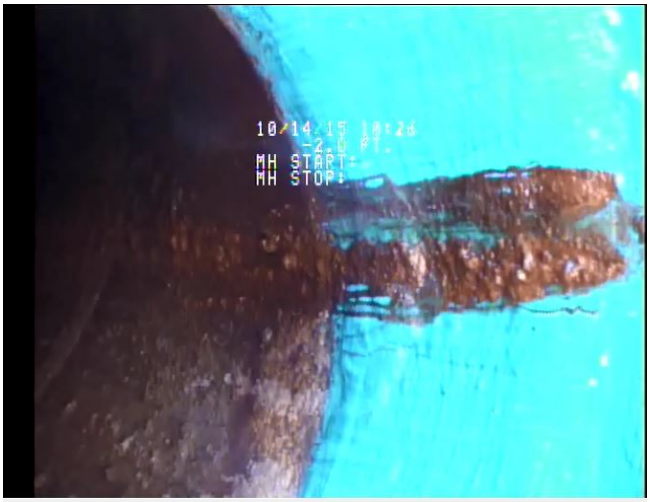
Estimated Water Main Construction Cost = $114,800

3.1.9.2 Significant Snapshots:

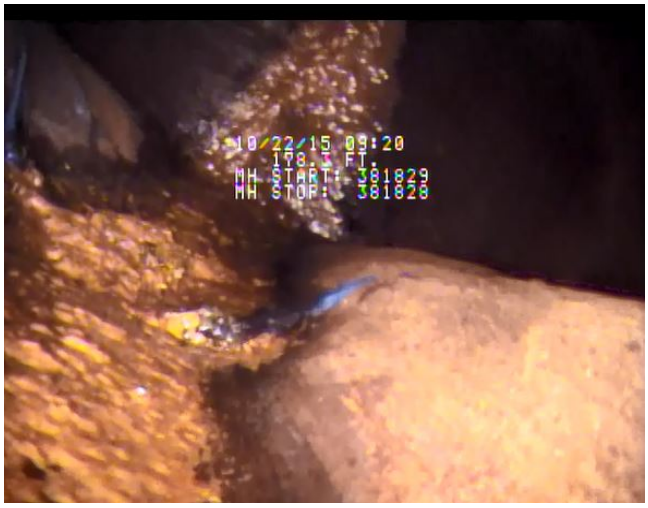
Several snapshots of defects found in the area are presented below.

Roots in Lateral

Attached Grease Going Into Sag



Leaking Chimney Seal



Significant MH I/I

Gushing Infiltration

3.1.10 LS # 54 North Falcon

3.1.10.1 Recommendation Summary

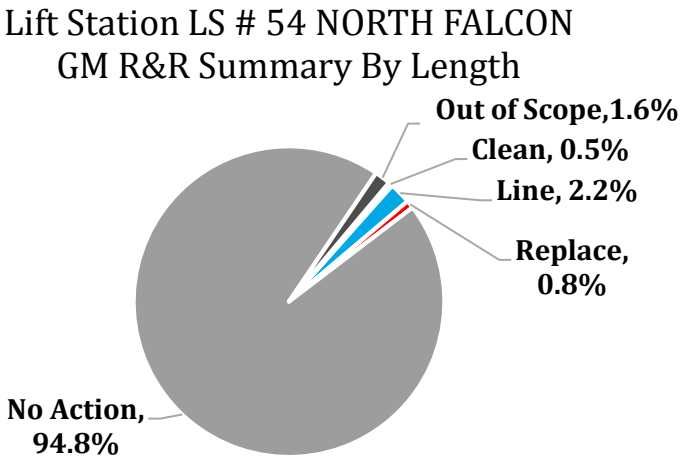
Gravity Mains

The gravity main piping in the North Falcon Lift Station Area includes both VCP and PVC sewers with most of the pipe in fair condition. Many of the tributary sewers are PVC, while the trunk sewer is VCP. Just like in adjacent lift station areas to the north, infiltration is a significant problem in the sewers and manholes.

Many of the tributary lines were found to be in good condition and most of the laterals appeared to be in good condition. There were several pipe sags into a downstream manhole which was common in this area. One pipe was found with so many sags, it is recommended to be replaced. Despite the number of observed issues with the VCP pipe joints, the lateral connections and piping that could be seen were found to be in relatively good condition.

Two (2) lateral liners are needed to repair defective lateral connections and piping. There are 4 spot repairs needed, with almost all of these being to repair small sagging segments of pipes entering manholes.

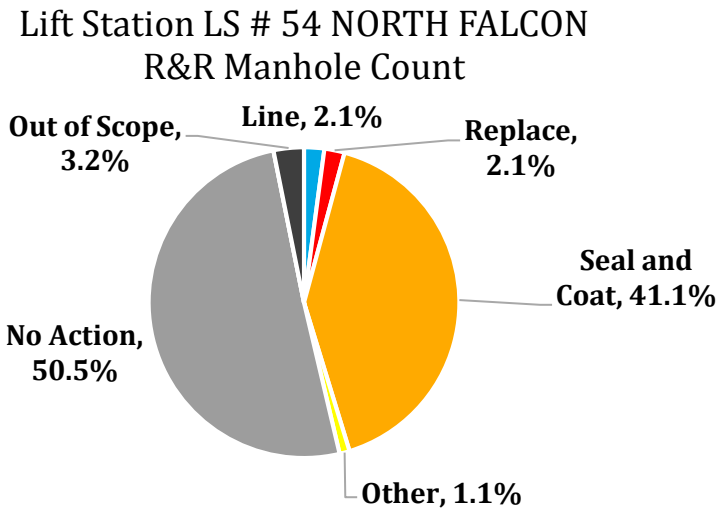
The chart below summarizes the recommendations for sewers in this area.



Manholes

All of the manholes in the area are precast concrete with brick chimneys. Chimney seals have been installed in the last several years on a number of manholes in the area. 40 manholes have been identified to be sealed and coated based on significant active infiltration on the walls. Two (2) manholes had signs of wall corrosion and should be lined. The manholes to be replaced were found on portions of pipe that had failed or sagged and are being replaced with the sewers.

The chart below summarizes the recommendations for the manholes in this area.



Out of Scope Assets

Inspection reports and videos were not provided for 406 feet (2%) of sewer and 3 (3%) manholes. It is difficult to determine why several of terminal upstream sewer reaches and manholes were not inspected. The adjacent sewers in these areas are PVC, and the service areas are small, so defects on these pipes pose a small risk. It is still recommended that these sewers and manholes be inspected to allow for all rehabilitation needs to be identified at this time.

Water Mains

There is one segment of sewer and one remote manhole to be replaced, both are located in Falcon Road and assumed to impact the existing water main.

Construction Considerations

The pipe replacement includes a 50 foot long spot repair and the upstream manhole to correct settled piping. The manhole replacement is also found on one end of a pipe to be lined. Based on the amount of work and the need to coordinate closely, it is recommended the adjacent rehabilitation work be completed after the spot repair work is done.

Preliminary Construction Costs

Estimated bare construction costs to complete the rehabilitation recommended above can be seen in the table below.

DESCRIPTION	ESTIMATED QUANTITIES	UNIT	UNIT PRICE ($)	COST ($)
Medium Cleaning Sanitary Sewer Mains (8" to 12" diameter)	230	LF	$2.00	$460.00
Sanitary Sewer Main 8-inch Diameter (8' to 10' depth)	205	LF	$65.00	$13,325.00
Sanitary Manholes 4-feet Diameter (8' - 10' depth)	2	EA	$5,400.00	$10,800.00
Install/Repair/Replace 4" Sanitary Sewer Lateral (10' to 15' depth @ main)	4	EA	$2,610.00	$10,440.00
Seal and Recoat Manhole (48" diameter)	320	VF	$300.00	$96,000.00
Fiberglass Manhole Insert (48" diameter)	2	EA	$6,500.00	$13,000.00
Re-construct Manhole Benching	2	EA	$700.00	$1,400.00
Sanitary Sewer Main CIPP Liner (10" diameter)	558	LF	$45.00	$25,110.00
FCLRL – CIPP Lateral Liner (6" diameter, ≤30 LF)	2	EA	$2,745.00	$5,490.00
Sanitary Sewer Main Point Repair (10' to 15' depth) (0-20 feet long) (Incl. Rd. Rest.)	4	EA	$15,000.00	$60,000.00
CIPP point repair, 8" diameter sanitary sewer main	1	EA	$4,500.00	$4,500.00
Milling and Resurfacing	273	SY	$11.00	$3,003.00
Asphalt Roadway Replacement (2"- 4" thick w/base)	228	SY	$45.00	$10,260.00
Water Main w/fittings & RJs (6" diameter)	522	LF	$26.00	$13,572.00
Water Main w/fittings & RJs (10" diameter)	154	LF	$30.00	$4,620.00
Gate Valve with Box (6" diameter)	2	EA	$1,150.00	$2,300.00
Gate Valve with Box (10" diameter)	2	EA	$2,125.00	$4,250.00
Fire Hydrant Assembly	1	EA	$3,230.00	$3,230.00
Water Service Connection (short side)	7	EA	$650.00	$4,550.00
Water Service Connection (long side)	7	EA	$1,125.00	$7,875.00
				$ 294,200.00

Estimated Trenchless Lining Construction Cost = $205,100

Estimated Open Cut Sewer Construction Cost = $47,800

Estimated Water Main Construction Cost = $38,300

3.1.10.2 Significant Snapshots:

Several snapshots of defects found in the area are presented below.

Full Pipe Sag

Attached Grease on Pipe Walls

Leaking Chimney Seal

Significant MH I/I

Missing Pipe Connection Seal at MH

3.1.11 LS # 55 South Falcon

3.1.11.1 Recommendation Summary

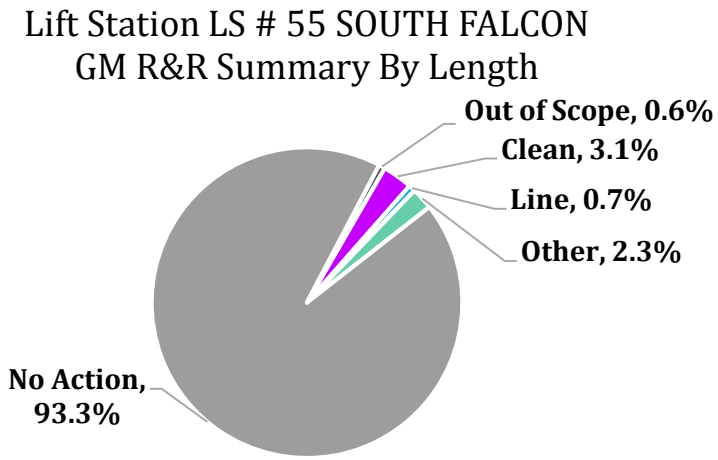
Gravity Mains

The gravity main piping in the South Falcon Lift Station Area is PVC with most of the pipe in good condition. Many of the tributary sewers are PVC, while the trunk sewer is VCP. Similar to the adjacent lift station areas to the north, infiltration is a significant problem in the sewers and manholes.

Only one pipe had enough issues to warrant lining, and that was the last pipe before the lift station. There were several offset joints that were recommended to be lined. Another pipe needed to have settled deposits cleaned, but the remaining sewers were in good condition.

Two (2) lateral are recommended to be lined to repair defective lateral connections and piping that has become plugged with soil. There is one pipe where a separated joint is leaking, and is recommended to be repaired with a spot liner.

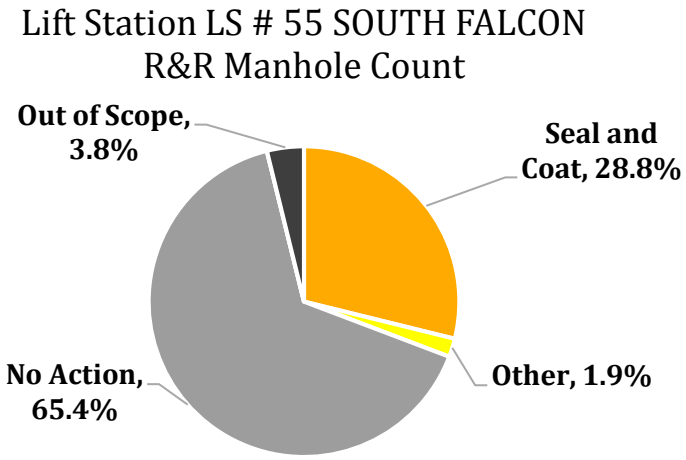
The chart below summarizes the recommendations for sewers in this area.



Manholes

All of the manholes in the area are precast concrete with brick chimneys. Chimney seals have been installed in the last several years on a number of manholes in the area. Fifteen (15) manholes have been identified to be sealed and coated based on significant active infiltration on the walls. There are no manholes in this area that require lining or replacement.

The chart below summarizes the recommendations for the manholes in this area.



Out of Scope Assets

Inspection reports and videos were not provided for 80 feet (1%) of sewer and 2 (4%) manholes. The far upstream sewer reach in Fulmer Court was not inspected. The adjacent sewers in these areas are PVC and it is a small tributary sewer branch, so defects in this pipe pose little risk. It is recommended that this sewer and two manholes be inspected to allow for all rehabilitation needs to be identified at this time.

Water Mains

There are no sewers being replaced in this area, therefore no water mains were included for replacement.

Construction Considerations

All of the proposed work in this area is trenchless and should be executed under a single contract. Due to the small amount of work to be done, this area could be combined with trenchless work from adjacent lift station areas.

Preliminary Construction Costs

Estimated bare construction costs to complete the rehabilitation recommended above can be seen in the table below.

DESCRIPTION	ESTIMATED QUANTITIES	UNIT	UNIT PRICE ($)	COST ($)
Medium Cleaning Sanitary Sewer Mains (8" to 12" Diameter)	399	LF	$2.00	$798.00
Seal and Recoat Manhole (48" Diameter)	150	VF	$300.00	$45,000.00
Sanitary Sewer Main CIPP Liner (10" Diameter)	87	LF	$45.00	$3,915.00
FCLRL – CIPP Lateral Liner (6" Diameter, ≤30 LF)	2	EA	$2,745.00	$5,490.00
CIPP Point Repair, 8" Diameter Sanitary Sewer Main	1	EA	$4,500.00	$4,500.00
				$ 59,800.00

Estimated Trenchless Lining Construction Cost = $59,800

Estimated Open Cut Sewer Construction Cost = N/A

There are no anticipated water main replacement costs in this area.

3.1.11.2 Significant Snapshots:

Several snapshots of defects found in the area are presented below.

Pipe Full of Sludge

Sagged Lateral

Leaking Break-in Lateral

Typical Manhole Condition

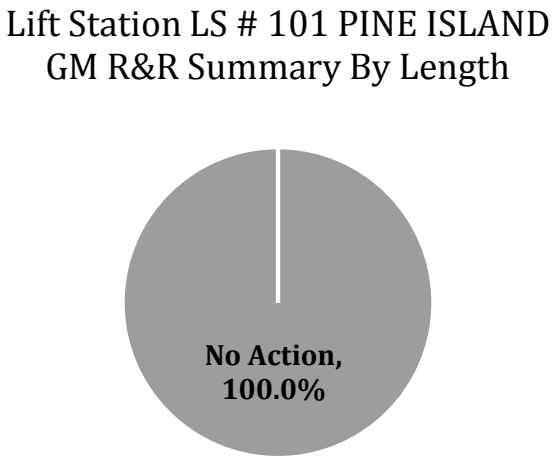
3.1.12 LS # 101 Pine Island

3.1.12.1 Recommendation Summary

Gravity Mains

All of the sewers in the pine Island Lift Station area are PVC and in relatively good condition. No sewers or laterals were found to need repair work at this time.

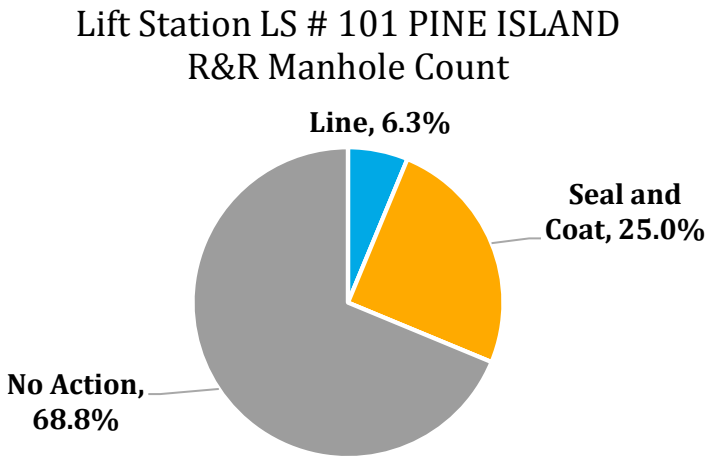
The chart below summarizes the recommendations for sewers in this area.



Manholes

All of the manholes in the area are precast concrete with brick chimneys. The brickwork in the chimneys was found to be in great condition. One (1) manhole, on two reaches of sewer downstream of the Admiral Court Lift Station, has a force main discharge and has excessive corrosion and is recommended be lined. A few manholes had infiltration issues, but were not corroded. It is recommend that these manholes be sealed and coated.

The chart below summarizes the recommendations for the manholes in this area.



Out of Scope Assets

The Pine Island Lift Station Area was fully inspected.

Water Main

There are no sewers being replaced in this area, therefore no water mains were included for replacement.

Construction Considerations

The only work to be completed in the Pine Island area is related to manhole rehabilitation which is completely trenchless. Due to the small amount of proposed work, it is recommended the Pine Island manhole rehabilitation be included with another project.

Preliminary Construction Costs

Estimated bare construction costs to complete the rehabilitation recommended above can be seen in the table below.

DESCRIPTION	ESTIMATED QUANTITIES	UNIT	UNIT PRICE ($)	COST ($)
Seal and Recoat Manhole (48" Diameter)	45	VF	$300.00	$13,500.00
Fiberglass Manhole Insert (48" Diameter)	1	VF	$6,500.00	$6,500.00
				$ 20,000.00

Estimated Trenchless Lining Construction Cost = $20,000

Estimated Open Cut Sewer Construction Cost = NA

3.1.12.2 Significant Snapshots:

Snapshots of defects found in the area are presented below.

Typical MH Chimney Condition

Corroded MH

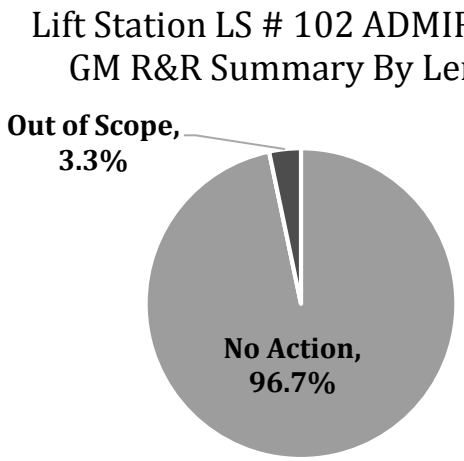
3.1.13 LS # 102 Admiral Court

3.1.13.1 Recommendation Summary

Gravity Mains

The Admiral Court Lift Station area includes both VCP and PVC sewers, all of which are in relatively good condition. No sewers or laterals were found to need repair work at this time.

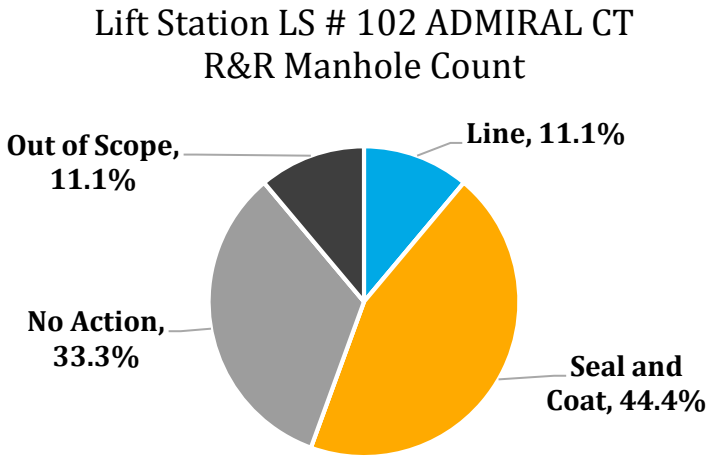
The chart below summarizes the recommendations for sewers in this area.



Manholes

All of the manholes in the area are precast concrete with brick chimneys. Most of the manholes in the area have signs of active infiltration at the manhole joints and at some pipe connections. No manholes showed any significant signs of structural distress or corrosion. These manholes are recommended to be sealed and coated.

The chart below summarizes the recommendations for the manholes in this area.



Out of Scope Assets

All of the Admiral Court Lift Station Area was fully inspected except for a stub pipe just off the lift station and a stub pipe on Riviera Drive. Considering the pipes are stubs, there is little concern of any significant defects being found in either of these reaches. All but one manhole were inspected, and that is the manhole immediately outside of the lift station. The pipe flowing into this manhole was completely full when it reached the manhole and this may explain why no inspection was performed. This may also be the lift station wet well and therefore not a manhole to be inspected under this project scope. Based on the location and character of the uninspected assets, there is low risk in proceeding with a project in this area.

Water Mains

There are no sewers being replaced in this area, therefore no water mains were included for replacement.

Construction Considerations

The only work to be completed in the Admiral Court area is related to manhole rehabilitation which is completely trenchless. Due to the small amount of proposed work, it is suggested to include the Admiral Court manhole rehabilitation in a group with other project(s).

Preliminary Construction Costs

Estimated construction costs to complete the rehabilitation recommended above can be seen in the table below.

DESCRIPTION	ESTIMATED QUANTITIES	UNIT	UNIT PRICE ($)	COST ($)
Seal and Recoat Manhole (48"Diameter)	40	VF	$300.00	$12,000.00
Fiberglass Manhole Insert (48" Diameter)	8	VF	$6,500.00	$6,500.00
				$ 18,500.00

Estimated Trenchless Lining Construction Cost = $18,500

Estimated Open Cut Sewer Construction Cost = NA

3.1.13.2 Significant Snapshots:

Several snapshots of defects found in the area are presented below.

Pipe Connection in MH to be Sealed

Silt in Lateral, no Visible Defect

3.1.14 LS # 33 Osceola Park

3.1.14.1 Recommendation Summary

Gravity Mains

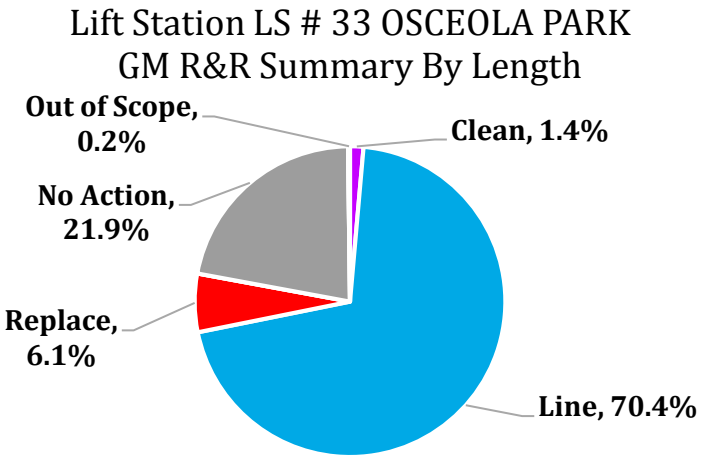
The gravity main piping in the Osceola Park Lift Station Area is older VCP where a majority of the joints are beginning to fail. Lateral connections are beginning to look questionable, however, not as many defects were observed at the main as expected and the laterals along any sewer that is called to be lined should be inspected for defects.

One segment of sewer located just south of the lift station in Eola Drive is recommended to be replaced. The pipe has multiple material changes and some grade issues, and cannot be repaired by trenchless methods.

There is one pipe with a utility cross bore that needs to be removed from the cross section of the pipe prior to lining.

Based on the types of defects and condition of the piping, a majority of the sewers in this area have been recommended for lining.

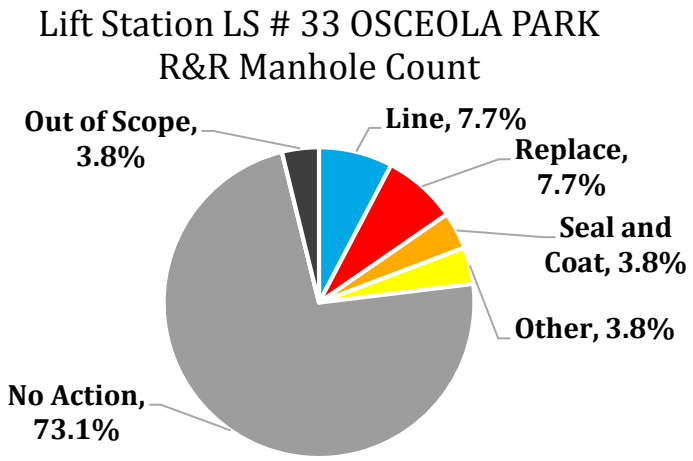
The chart below summarizes the recommendations for sewers in this area.



Manholes

All of the manholes in the area are precast concrete with several beginning to show excessive signs of corrosion. The manholes on each end of the sewer line to be replaced will also be replaced due to condition and to aid in correcting grade issues in the sewer. Two (2) manholes need to be sealed and coated and two manholes, including one on the reach of sewer just upstream of the lift station, is recommended to be lined.

The chart below summarizes the recommendations for the manholes in this area.



Out of Scope Assets

Inspection reports and videos were not provided for 13 feet (0.2%) of sewer and 1 (4%) manhole. This appears to be the last segment of pipe into the lift station and a manhole at the lift station site (or the lift station wet well). This pipe should be inspected as two of the sewers upstream are recommended to be lined and the upstream manhole is recommended to be replaced.

Water Main

There is one reach of sewer being replaced in the Osceola Park lift station area in Eola Drive, however the 6-inch main is PVC and was not included for replacement.

Construction Considerations

The majority of work to be done in the area is trenchless, but due to the location of the open cut replacement pipes, it is recommended that the replacement be completed in advance of the lining. It may be possible to combine the work, as the open cut replacement is a small amount of the work.

Preliminary Construction Costs

Estimated construction costs to complete the rehabilitation recommended above can be seen in the table below.

DESCRIPTION	ESTIMATED QUANTITIES	UNIT	UNIT PRICE ($)	COST ($)
Medium Cleaning Sanitary Sewer Mains (8" to 12" Diameter)	91	LF	$2.00	$182.00
Sanitary Sewer Main 10” Diameter (8' to 10' Depth)	396	LF	$85.00	$33,660.00
Sanitary Manholes 4’ Diameter (8' to 10' Depth)	2	EA	$5,400.00	$10,800.00
Seal and Recoat Manhole (48" Diameter)	18	VF	$300.00	$5,400.00
Fiberglass Manhole Insert (48" Diameter)	2	EA	$6,500.00	$13,000.00
Install/Repair/Replace 4" Sanitary Sewer Lateral (10' to 15' Depth @ Main)	8	EA	$2,610.00	$20,880.00
Sanitary Sewer Main CIPP Liner (8" Diameter)	3,924	LF	$40.00	$156,960.00
Sanitary Sewer Main CIPP Liner (10" Diameter)	670	LF	$45.00	$30,150.00
Sanitary Sewer Main Point Repair (6' to 10' Depth) (0 -10 feet long) (Incl. Road Rest.)	3	EA	$10,000.00	$30,000.00
Milling and Resurfacing	528	SY	$11.00	$5,808.00
Asphalt Roadway Replacement (2" to 4" thick w/base)	440	SY	$45.00	$19,800.00
				$ 326,700.00

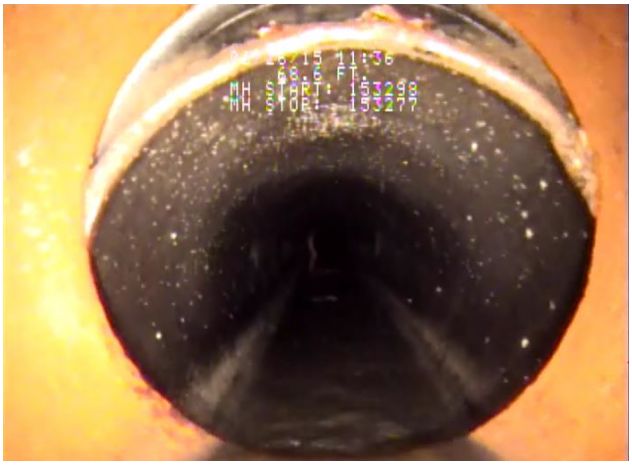
Estimated Trenchless Lining Construction Cost = $235,700

Estimated Open Cut Sewer Construction Cost = $91,000

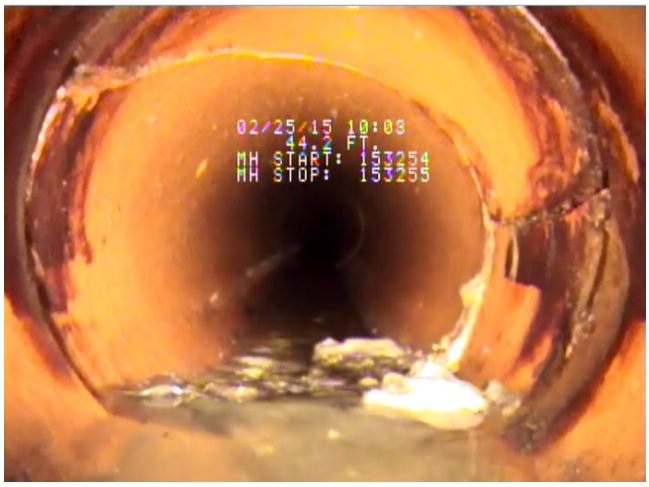
3.1.14.2 Significant Snapshots:

Several snapshots of defects found in the area are presented below.

Cross Bore Through Pipe

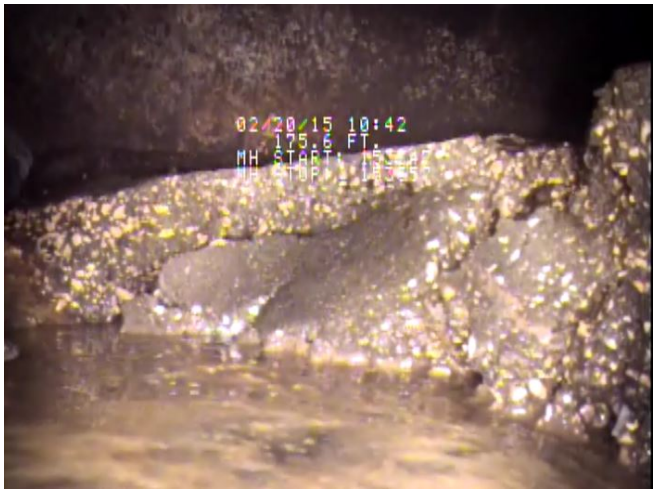


Offset Repair Connection



Multiple Fracture

Typical Manhole Condition



Crumbling MH Bench

3.1.15 LS # 34 K&Y

3.1.15.1 Recommendation Summary

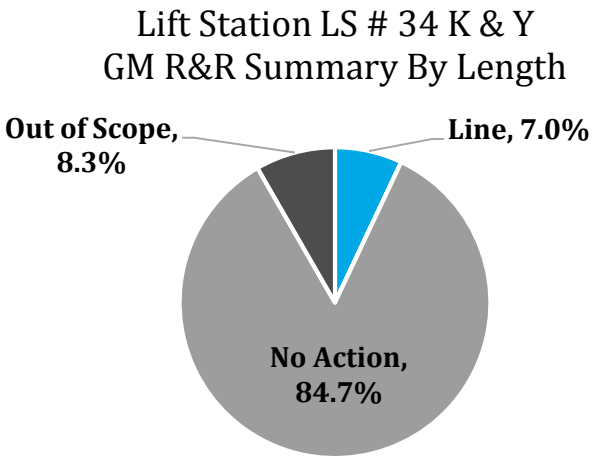
Gravity Mains

The sewers in the K&Y lift station service area are PVC with precast concrete manholes. The sewers and manholes were all in very good condition.

There are a few service connections on the lined sewer that appear to have some voids around the connection. There are no signs of any infiltration, so these observations may not actually be defects, but rather features of that particular tapping product.

Several of the lined sewers had some minor sagging, but no defects that should cause operational issues. The first sewer reach north of the lift station, that was previously lined, exhibited continuous longitudinal cracking and infiltration staining along the length of the pipe. Without additional information on the existing liner, it cannot be evaluated for long term effectiveness, so the sewer is currently being recommended to be re-lined. If re-lining is not feasible, then it may be necessary to replace the sewer.

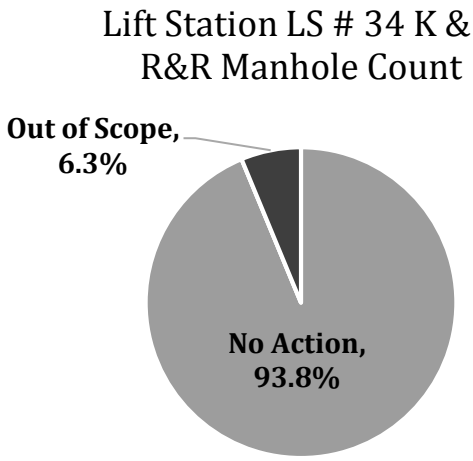
The chart below summarizes the recommendations for sewers in this area.



Manholes

All of the manholes in the area are precast concrete or lined manholes where the underlying material is unknown. No repairs to manholes are recommended in this area.

The chart below summarizes the recommendations for the manholes in this area.



Out of Scope Assets

Inspection reports and videos were not provided for 225 feet (8%) of sewer and 1 (6%) manhole. There are two pipes connected to the one manhole that have not been inspected and there is no clear link to the other gravity main piping in the area. It is recommended to identify how these pipes and manhole connect and perform inspections.

Water Mains

There are no sewers being replaced in this area, therefore no water mains were included for replacement.

Construction Considerations

The only work to be completed in this area is a single sewer reach recommended to be lined. Due to the small amount of proposed work, it is suggested to include this work in a group with other project(s).

Preliminary Construction Costs

Estimated bare construction costs to complete the rehabilitation recommended above can be seen in the table below.

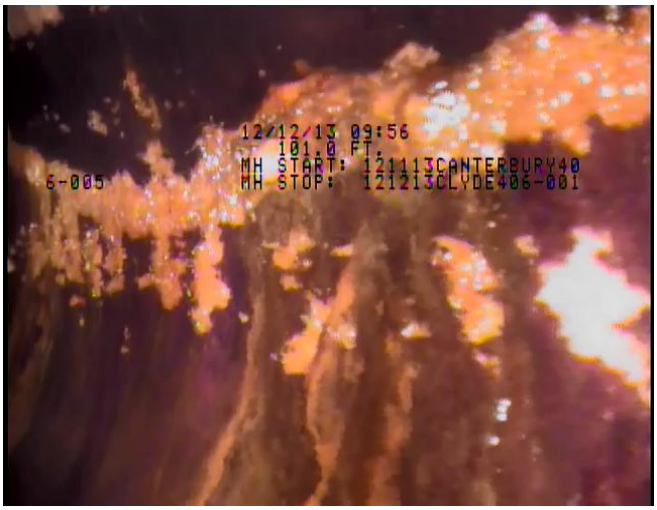
DESCRIPTION	ESTIMATED QUANTITIES	UNIT	UNIT PRICE ($)	COST ($)
Sanitary Sewer Main CIPP Liner (8" Diameter)	190	LF	$40.00	$7,600.00
				$ 7,600.00

Estimated Trenchless Lining Construction Cost = $7,600

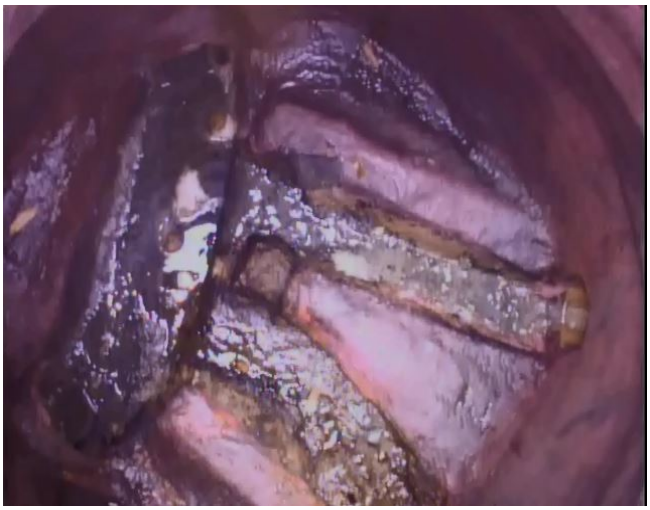
Estimated Open Cut Sewer Construction Cost = NA

3.1.15.2 Significant Snapshots:

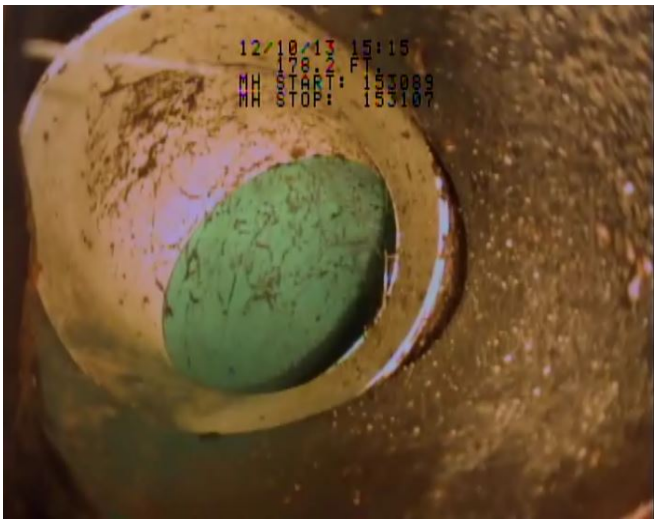
Several snapshots of defects found in the area are presented below.



Fractured Liner with I/I



Lined Manhole



Lateral on Lined Sewer

3.1.16 LS # 35 Lake Front

3.1.16.1 Recommendation Summary

Gravity Mains

The Lake Front lift Station area is the second largest area reviewed, consisting of 124,144 feet of gravity main and 542 manholes. The system is located in the downtown area and has older areas with VCP and concrete pipes and brick manholes as well as newer and reconstructed areas that have PVC pipes and precast concrete manholes.

Some of the pipe assets in this area were broken up into multiple line segments for the same manhole to manhole reach of sewer. In most cases the different segments represented pipe with different materials, however this was not consistently applied across the entire system. This led to issues with linking inspections to the correct asset and complicated review efforts. It is suggested that whole pipes are provided a unique ID, and that individual segments be isolated by separate but related IDs to allow for smooth sorting in the future. This was one of the factors inflating the amount of uninspected sewer.

There are also sizeable areas that have already had trenchless rehabilitation work completed throughout the area. Areas that had rehabilitation completed or scheduled after the inspection phase were not included in the recommendations discussions below.

There are approximately 4 segments of sewer that are recommended for cleaning, and all are related to blockages of sludge or dirt that prevented full inspections of the pipes. There were areas of attached grease, but nothing to the extent of having pipes blocked. These sewers should be cleaned and fully inspected to identify any defects or the source of the blockages.

65 individual pipe segments have been recommended to be lined, totaling approximately 14,122 feet. Sewers to be lined were nearly all VCP, with some sewers including partial lengths of DIP that will be lined through to provide long-term protection. VCP pipe that was found to be holding shape, have positive slope with minor sagging, and decent lateral connections were identified as good candidates for lining. Approximately 65 laterals were identified for lining to correct issues with cracks, fractures and separating joints that could be cleanly rehabilitated without excavation. There were 7 spot liners recommended to repair pipelines with singular defects, typically at joints.

There are 31 spot repairs needed throughout the project area. Spot repairs are called out to fix issues that cannot be corrected through lining alone. Defects such as sags or offset joints can restrict the equipment used to perform trenchless rehabilitation and need to be corrected in advance of lining. In other cases, spot repairs may be performed to repair a lateral connection that cannot properly be accessed and repaired form the main or to correct isolated defects on VCP or PVC sewers that are in otherwise good condition (i.e. utility cross-bores).

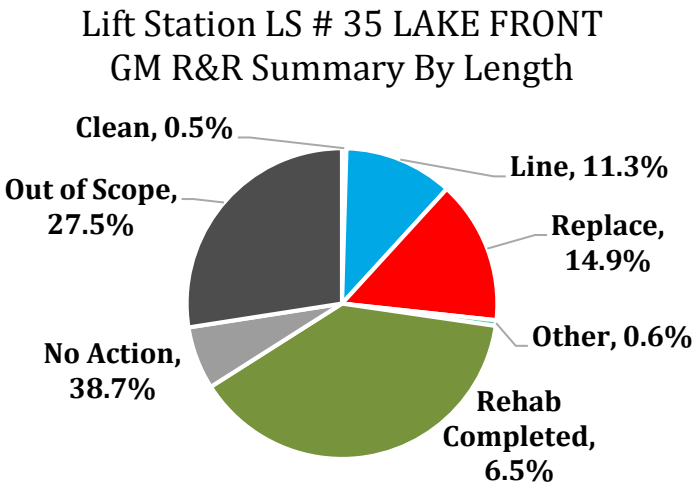
Pipes that required multiple spot repairs or excavations were evaluated for cost effectiveness versus full replacement. Similar repair cost estimates were considered to determine if the rehabilitation or replacement would provide a higher quality end product.

77 sewer segments, totaling 18,532 feet are recommended to be replaced. Sewers to be replaced are scattered throughout the project area and typically consist of sewers that either have defects that cannot be feasibly repaired using trenchless methods or sewers with so many defects to be addressed that the sum of all trenchless repairs would exceed the cost of open cut replacement. There were a handful of discreet areas where replacement is needed due to a particular recurring defect.

- W. Vine Street west of N. Central Avenue – Pipes on each side of the street are made of DIP or CI and were severely restricted due to wall scale buildup, failed joints, and excessive sagging. These pipes would not be good candidates for lining even if the scale were successfully removed because of the poor line and grade of the sewer.

- Robinson Avenue, Palmway Street, Brack Street and Bay Street between Park Street and West Vine Street – These north-south sewers were all found to be older VCP in very poor condition. Lateral issues were very prevalent in these areas and nearly every lateral along the line was defective and in need of rehabilitation, making replacement the best option. Closer to Vine Street laterals to abandoned properties appear to become a bigger issue, complicating lining efforts, as not all of the observed taps appeared to be actively in service.

The chart below summarizes the recommendations for sewers in this area.



Manholes

The manholes in the area include structures with brick and precast concrete walls. The manholes were found to be in various conditions. For example there were areas where the brick manholes were in very good condition, and some where there was missing mortar and bricks and heavy infiltration. The condition of the manholes in some cases followed along with the condition of the sewers and rehabilitation recommendations considered the proposed pipe rehabilitation techniques.

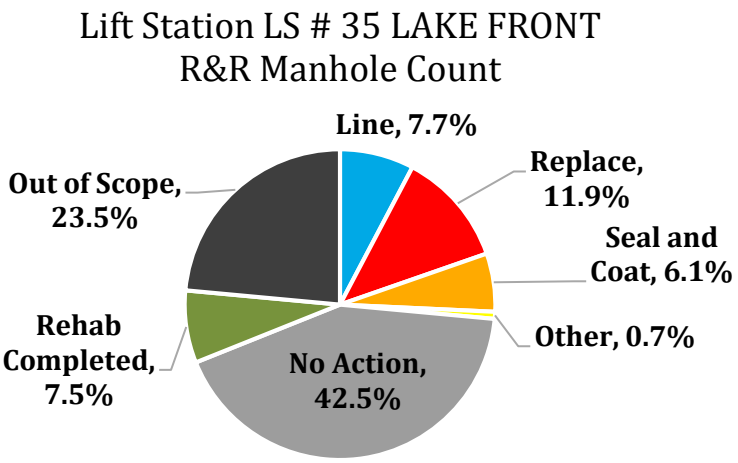
42 manholes in the area are recommended to be lined. These manholes are scattered throughout the area, generally following some of the sewer rehabilitation areas. If a manhole exhibited structural defects (missing mortar or bricks in brick manholes, or surface damage and wall loss in precast concrete manholes), a liner was recommended.

33 manholes had notable infiltration, either at the chimney, walls or pipe penetrations, and were free of structural defects and are recommended to be sealed and recoated to halt further infiltration.

There were 6 manholes with brick benches that had begun to crumble and hold up flow. In these cases, it was recommended to reconstruct the manhole benching and flow channels.

65 manholes in the areas need to be replaced. A majority of them are found along reaches of sewer to be replaced and would not be feasible to remain in place. Another set of manholes are being replaced to correct settling and grade issues. There were also several manholes that are recommended for replacement due to irregularities including: having no or failing drop connections, soil infiltrating through holes or fractures, or in some cases the pipe terminated at a plug and required an upstream manhole to perform maintenance or rehabilitation.

The chart below summarizes the recommendations for the manholes in this area.



Out of Scope Assets

Inspection reports and videos were not provided for 34,085 feet (27%) of sewer and 128 (24%) manholes, as they were not included in the scope of this project. There was also 8,123 feet of gravity mains and associated manholes that had been recently reconstructed and/or rehabilitated by TWA. There are several runs of sewer where inspections were not completed due to unknown reasons. In some cases the adjacent pipes were showing signs of high water, sedimentation, difficult traffic control or poor condition, which may indicate the reason the inspections were not obtained. Considering the amount of sewers and manholes not inspected, it is recommended that the remaining inspections be completed. Due to the size of this project, and the amount of sewer that has yet to be inspected, the work could be completed in phases, allowing TWA to complete the missing inspections.

Water Main

There are 77 sewer segments of sewer being replaced throughout the area totaling nearly 19,000 feet. 18,625 feet of water main was identified in the same streets as these replacements, however the majority of the water mains in these areas meet current TWA standards and only 6,650 feet of water main was found to be either nonstandard size or material. In some of the neighborhoods where the sewer replacement is not contiguous and the water main is confirmed to be nonstandard, it is typical best practice to replace the full length of water main across those areas.

Construction Considerations

The Lakefront area is very large and includes sewer work that is spread across the entire area. The scope of an open cut replacement project would be complex and may have project management issues related to the spread between work zones, traffic control and detour impacts. Sequencing between open cut work and trenchless rehabilitation work will be difficult. The size and scope of this project area may require a different contract method where the rehabilitation plans are more of a work order list for a contractor to work on annually until all of the work is completed.

Preliminary Construction Costs

Estimated construction costs to complete the rehabilitation recommended above can be seen in the table below.

DESCRIPTION	ESTIMATED QUANTITIES	UNIT	UNIT PRICE ($)	COST ($)
Medium Cleaning Sanitary Sewer Mains (8" to 12" Diameter)	568	LF	$2.00	$1,136.00
Sanitary Sewer Main 8” Diameter (8' to 10' Depth)	17,315	LF	$65.00	$1,125,475.00
Sanitary Sewer Main 10” Diameter (8' to 10' Depth)	636	LF	$85.00	$54,060.00
Sanitary Sewer Main 12” Diameter (8' to 10' Depth)	241	LF	$90.00	$21,690.00
Sanitary Sewer Main 16” Diameter (8' to 10' Depth)	229	LF	$105.00	$24,045.00
Sanitary Sewer Main 18” Diameter (8' to 10' Depth)	89	LF	$125.00	$11,125.00
Sanitary Sewer Main 24” Diameter (8' to 10' Depth)	22	LF	$150.00	$3,300.00
Sanitary Manholes 4’ Diameter (8' - 10' Depth)	65	EA	$5,400.00	$351,000.00
Seal and Recoat Manhole (48" Diameter)	330	VF	$300.00	$99,000.00
Fiberglass Manhole Insert (48" Diameter)	42	EA	$6,500.00	$273,000.00
Re-construct Manhole Benching	6	EA	$700.00	$4,200.00
Install/Repair/Replace 4" Sanitary Sewer Lateral (10' to 15' Depth @ Main)	371	EA	$2,610.00	$968,310.00
Sanitary Sewer Main CIPP Liner (8" Diameter)	11,252	LF	$40.00	$450,080.00
Sanitary Sewer Main CIPP Liner (10" Diameter)	229	LF	$45.00	$10,305.00
Sanitary Sewer Main CIPP Liner (12" Diameter)	1,003	LF	$50.00	$50,150.00
Sanitary Sewer Main CIPP Liner (15" Diameter)	1,236	LF	$55.00	$67,980.00
Sanitary Sewer Main CIPP Liner (18" Diameter)	337	LF	$60.00	$20,220.00
FCLRL – CIPP Lateral Liner (6" Diameter, ≤30 LF)	65	EA	$2,745.00	$178,425.00
Sanitary Sewer Main Point Repair (6' to 10' Depth) (0 to 10 feet long) (Incl. Road Rest.)	25	EA	$10,000.00	$250,000.00

Estimated construction costs - continued

DESCRIPTION	ESTIMATED QUANTITIES	UNIT	UNIT PRICE ($)	COST ($)
Sanitary Sewer Main Point Repair (10' to 15' Depth) (0 to 20 feet long) (Incl. Rd. Rest.)	6	EA	$15,000.00	$90,000.00
CIPP Point Repair, 8" Diameter Sanitary Sewer Main	7	EA	$4,500.00	$31,500.00
Milling and Resurfacing	24,709	SY	$11.00	$271,799.00
Asphalt Roadway Replacement (2" to 4" thick w/base)	20,591	SY	$45.00	$926,595.00
Water Main w/fittings & RJs (6" Diameter)	17,332	LF	$26.00	$450,632.00
Water Main w/fittings & RJs (8" Diameter)	218	LF	$28.00	$6,104.00
Water Main w/fittings & RJs (12" Diameter)	1,104	LF	$32.00	$35,328.00
Gate Valve with Box (6" Diameter)	35	EA	$1,150.00	$40,250.00
Gate Valve with Box (8" Diameter)	1	EA	$1,450.00	$1,450.00
Gate Valve with Box (12" Diameter)	3	EA	$2,800.00	$8,400.00
Fire Hydrant Assembly	19	EA	$3,230.00	$61,370.00
Water Service (short side)	187	EA	$650.00	$121,550.00
Water Service (long side)	187	EA	$1,125.00	$210,375.00
				$ 6,218,900.00

Estimated Trenchless Lining Construction Cost = $1,526,000

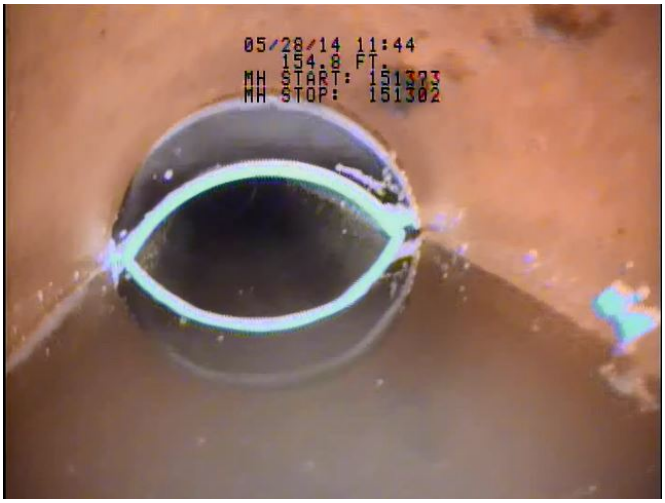
Estimated Open Cut Sewer Construction Cost = $3,757,400

Estimated Water Main Construction Cost = $935,500

3.1.16.2 Significant Snapshots:

Several snapshots of defects found in the area are presented below.

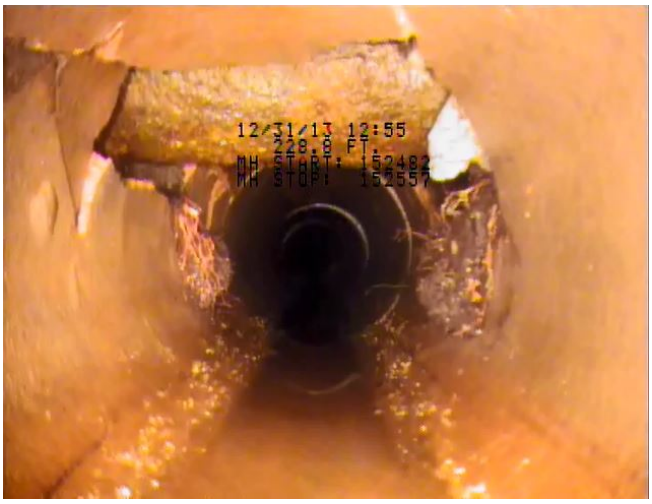
Collapsed Pipe



Offset MMC

Brick Manhole Chimney

Utility Cross Bore



Potential Conflict Pipe

Precast Manhole Reinforcement

Concrete Pipe Corrosion

Failed Tap Connection

3.1.17 LS # 36 Neptune Point

3.1.17.1 Recommendation Summary

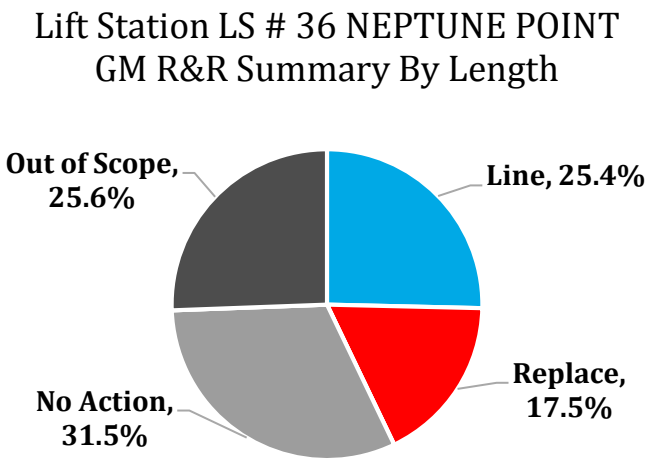
Gravity Mains

The gravity main piping in the Neptune Point Lift Station area is primarily VCP and is in relatively poor condition.

Eight (8) reaches of sewer, all in Westchester Lane need to be replaced. These VCP sewers had too many individual defects to effectively line the sewer.

Of the remaining sewers that were inspected, seven (7) were recommended to be lined to alleviate issues due to cracking and fractures. There are two open cut spot repairs, one to fix a severely offset joint and another to remove a utility cross-bore through the existing main. One sewer had a failed service lateral and is recommended be lined.

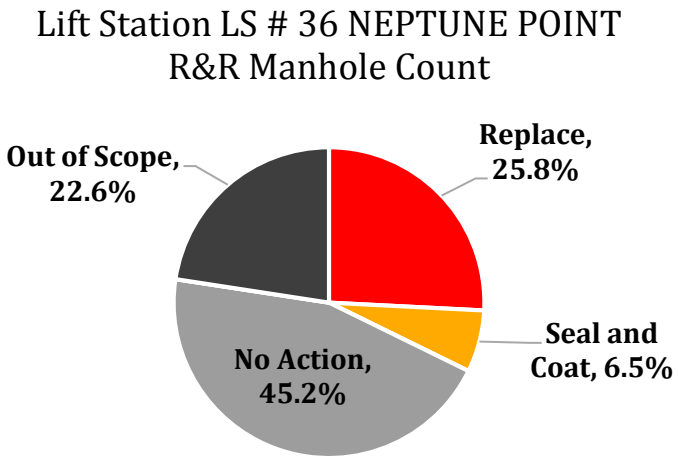
The chart below summarizes the recommendations for sewers in this area.



Manholes

All of the manholes in the Neptune Point area are brick manholes. These manholes are in good structural condition, however 2 manholes exhibit active infiltration and need to be sealed and coated. The 8 manholes found along the sewer to be replaced in Westchester Lane are recommended to be replaced during the sewer construction.

The chart below summarizes the recommendations for the manholes in this area.



Out of Scope Assets

Inspection reports and videos were not provided for 1,725 feet (26%) of sewer and 7 (23%) manholes. All of the uninspected sewers are found along Neptune Road. There were no signs of anything unusual from the inspections immediately upstream of the incomplete area, so accessibility may have been the restriction to completing the initial inspections. It is recommended that the remaining VCP sewers and brick manholes be inspected prior to preparing final recommendations.

Water Main

All of the water main in Westchester Lane where the sewer replacement is located is 6-inch diameter of unknown material and also includes a 2-inch service loop at the cul-de-sac. It is recommended to replace this water main during the sewer replacement project.

Construction Considerations

The pipe recommended to be replaced in Westchester includes manhole replacements on several pipes recommended for lining. To avoid sequencing issues, it is recommended that the open cut replacement project be executed before the lining project. This would allow for the trenchless rehabilitation work to be bid as a separate project from the pipe replacement.

Preliminary Construction Costs

Estimated construction costs to complete the rehabilitation recommended above can be seen in the table below.

DESCRIPTION	ESTIMATED QUANTITIES	UNIT	UNIT PRICE ($)	COST ($)
Sanitary Sewer Main 8” Diameter (8' to 10' Depth)	1,181	LF	$65.00	$76,765.00
Sanitary Manholes 4’ Diameter (8' to 10' Depth)	8	EA	$5,400.00	$43,200.00
Install/Repair/Replace 4" Sanitary Sewer Lateral (10' to 15' Depth @ Main)	24	EA	$2,610.00	$62,640.00
Sanitary Sewer Main CIPP Liner (8" Diameter)	1,709	LF	$40.00	$68,360.00
Seal and Recoat Manhole (48" Diameter)	20	VF	$300.00	$6,000.00
FCLRL – CIPP Lateral Liner (6" Diameter, ≤30 LF)	1	EA	$2,745.00	$2,745.00
Sanitary Sewer Main Point Repair (6' to 10' Depth) (0 to 10 feet long) (Incl. Road Rest.)	2	EA	$10,000.00	$20,000.00
Sanitary Sewer Main Point Repair (10' to 15' Depth) (0-20 feet long) (Incl. Rd. Rest.)	1	EA	$15,000.00	$15,000.00
Milling and Resurfacing	1,575	SY	$11.00	$17,325.00
Asphalt Roadway Replacement (2" to 4" thick w/base)	1,312	SY	$45.00	$59,040.00
Water Main w/fittings & RJs (6" Diameter)	1,563	LF	$26.00	$40,638.00
Gate Valve with Box (6" Diameter)	4	EA	$1,150.00	$4,600.00
Fire Hydrant Assembly	2	EA	$3,230.00	$6,460.00
Water Service (short side)	16	EA	$650.00	$10,400.00
Water Service (long side)	16	EA	$1,125.00	$18,000.00
				$ 451,200.00

Estimated Trenchless Lining Construction Cost = $112,100

Estimated Open Cut Sewer Construction Cost = $259,000

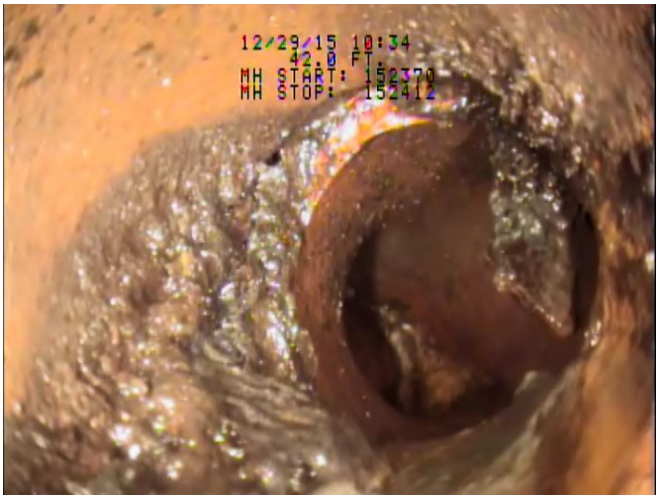
Estimated Water Main Construction Cost = $80,100

3.1.17.2 Significant Snapshots:

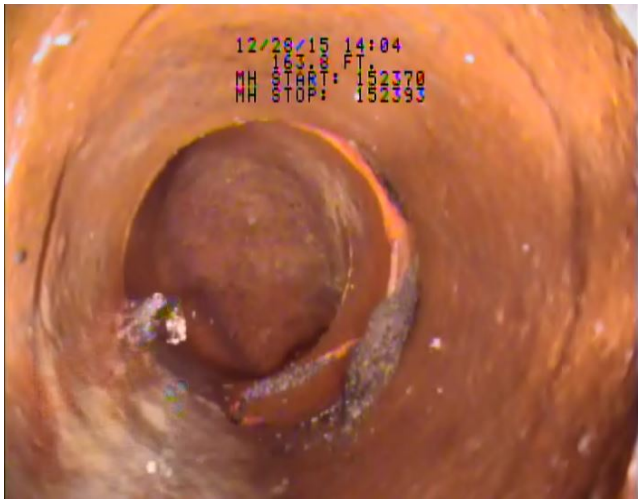
Several snapshots of defects found in the area are presented below.

Utility Cross Bore

Gushing I/I with Sand in Pipe



Broken Lateral



Fractured Pipe

Typical Brick Manhole Condition

3.1.18 LS # 45 Johnson Park

3.1.18.1 Recommendation Summary

Gravity Mains

The gravity main piping in the Johnson Park lift station area is split into two distinct areas. The area south of E. Columbia Avenue is older VCP that has been lined and the area to the north is PVC with several VCP sewers scattered through the area.

The PVC pipe is in very good condition, however there is one common defect where the pipe typically transitions to DIP under pavement and the DIP cement lining has fallen away and the metal pipe walls have scaled over causing a reduction in pipe diameter. There are 2 locations where it is recommended to clean off the buildup and install a spot liner to prevent further wall corrosion.

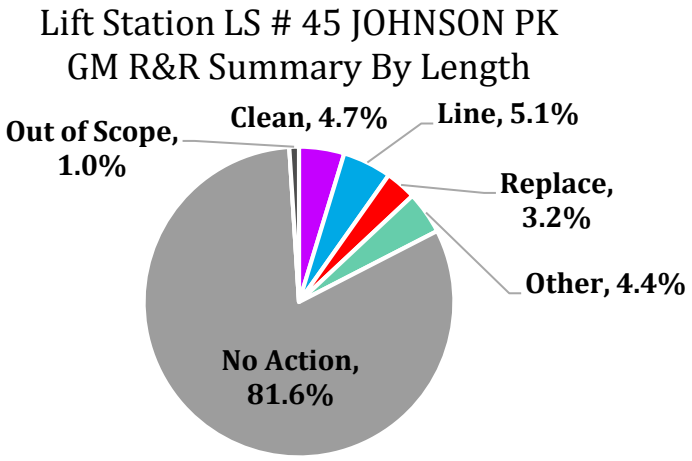
There is a single segment of VCP sewer in the PVC area that is cracking and has poor joints and is recommended to be lined.

The lined VCP pipe looks good with only minor sagging and no real operational issues, except for the pipes upstream along the trunk line. Around Delaware Avenue, the pipe shows signs of high water and surcharging and the inspection data is limited. While this area was defined as out of the project scope, there may be some capacity restrictions in the existing trunk line that is recommended to be investigated.

The lined sewers look good, but there are approximately 20 lateral connections along these lined sewers that are in need of rehabilitation and are recommended to be lined. The defects are visible from the main and occur immediately inside the latera and in many cases enter the main. The majority of these defects may be addressed through trenchless methods, however one or two may require excavation.

There are two reaches of sewer that were previously lined in Lehigh Street that have severe lateral issues where 3+ laterals on each reach requires excavation to repair. The cost to attempt to trenchlessly repair these pipes in conjunction with open cut spot repairs would exceed the cost of replacement.

The chart below summarizes the recommendations for sewers in this area.

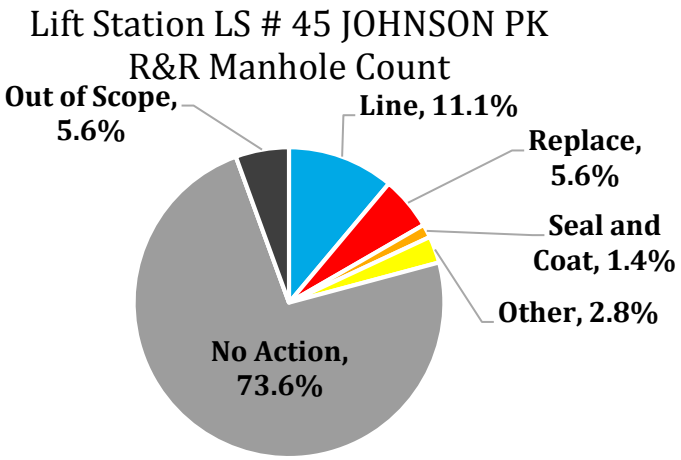


Manholes

The manholes north of E. Columbia Avenue are precast concrete. The manholes south of E. Columbia Avenue are brick, with mortared walls and many of the manholes have been lined in the recent past, likely when the sewers

were lined. There are a handful of manholes in the older area that are recommended to be replaced due to poor condition and adjacent construction impacts. There are 8 older brick manholes that were not lined during the last round of construction and are recommended be lined based on condition.

The chart below summarizes the recommendations for the manholes in this area.



Out of Scope Assets

Inspection reports and videos were not provided for 176 feet (1%) of sewer and 4 (6%) manholes. This includes two small sewer segments between Columbia Avenue and Ocean Street along Marlboro Avenue and an alley. There were no apparent reasons why the manhole inspections were not included, however based on the adjacent findings, it is unlikely that many of the uninspected manholes will require action other than seal and coat. It is recommended that the remaining VCP sewers and brick manholes be inspected prior to construction.

Water Mains

There is approximately 600 feet of water main included to be replaced with the sewer in Lehigh Street, and an additional 100 feet in Ocean Street coinciding with the manhole and spot repair work at Kingdom Avenue. The size and material of these mains is undocumented and the replacement diameter was selected to match adjacent water mains.

Construction Considerations

The pipe recommended to be replaced is found along sewer reaches on Lehigh Street and will not overlap with any of the trenchless recommendations. This would allow for the trenchless rehabilitation work to be bid as a separate project from the pipe replacement.

Preliminary Construction Costs

Estimated construction costs to complete the rehabilitation recommended above can be seen in the table below.

DESCRIPTION	ESTIMATED QUANTITIES	UNIT	UNIT PRICE ($)	COST ($)
Medium Cleaning Sanitary Sewer Mains (15" to 24" diameter)	1,658	LF	$4.00	$6,632.00
Sanitary Sewer Main 10-inch Diameter (8' to 10' depth)	568	LF	$85.00	$48,280.00
Sanitary Manholes 4-feet Diameter (8' - 10' depth)	5	EA	$5,400.00	$27,000.00
Install/Repair/Replace 4" Sanitary Sewer Lateral (10' to 15' depth @ main)	11	EA	$2,610.00	$28,710.00
Seal and Recoat Manhole (48" diameter)	10	VF	$300.00	$3,000.00
Fiberglass Manhole Insert (48" diameter)	8	EA	$6,500.00	$52,000.00
Re-construct Manhole Benching	2	EA	$700.00	$1,400.00
Sanitary Sewer Main CIPP Liner (8" diameter)	895	LF	$40.00	$35,800.00
FCLRL – CIPP Lateral Liner (6" diameter, ≤30 LF)	24	EA	$2,745.00	$65,880.00
Sanitary Sewer Main Point Repair (6' to 10' depth) (0 -10 feet long) (Incl. Road Rest.)	2	EA	$10,000.00	$20,000.00
Sanitary Sewer Main Point Repair (10' to 15' depth) (0-20 feet long) (Incl. Rd. Rest.)	1	EA	$15,000.00	$15,000.00
CIPP point repair, 8" diameter sanitary sewer main	1	EA	$4,500.00	$4,500.00
Milling and Resurfacing	757	SY	$11.00	$8,327.00
Asphalt Roadway Replacement (2"- 4" thick w/base)	631	SY	$45.00	$28,395.00
Water Main w/fittings & RJs (6" diameter)	705	LF	$26.00	$18,330.00
Gate Valve with Box (6" diameter)	2	EA	$1,150.00	$2,300.00
Fire Hydrant Assembly	1	EA	$3,230.00	$3,230.00
Water Service Connection (short side)	8	EA	$650.00	$5,200.00
Water Service Connection (long side)	8	EA	$1,125.00	$9,000.00
				$ 383,000.00

Estimated Trenchless Lining Construction Cost = $204,300

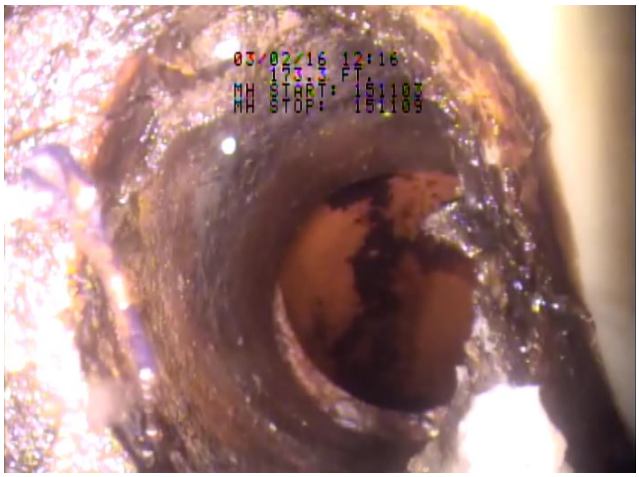
Estimated Open Cut Sewer Construction Cost = $140,800

Estimated Water Main Construction Cost = $38,100

3.1.18.2 Significant Snapshots:

Several snapshots of defects found in the area are presented below.

Fractured Lateral on Lined Main



Poorly Cut Active Lateral

DIP Pipe Segment with Scale

Typical MH Brickwork

Missing Brick Flow Channel

3.1.19 LS # 53 Old Winn Dixie

3.1.19.1 Recommendation Summary

Gravity Mains

The gravity main piping in the Old Winn Dixie lift station area is older VCP that is in poor condition. There are different types of defects in various locations throughout the area where repairs are recommended. In general, pipe sagging was a common issue in both the older VCP and newer PVC sewers.

It was also noted that many of the sewers had high water marks indicating that a number of the pipe reaches run full and may be undersized. It is recommended that the capacity of the sewer be investigated to confirm replacement.

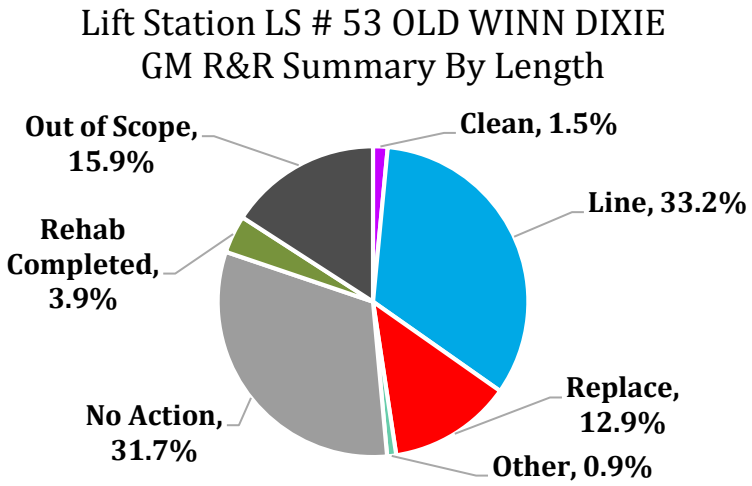
Approximately 3,000 feet of sewer is recommended for replacement in the following locations:

- Cross lot sewer behind Family Dollar has multiple sags that are recommended to be lined.
- Smith Street south of E. Columbia Avenue may be undersized. The pipe has been tapped so many times, that the main is beginning to crumble.
- Smith/Dolphin/Brack Streets have VCP sewers that are fractured and sagging and recommended for replacement.

Several of the sewers along the creek have excessive settlement and sagging and require partial replacement to eliminate full pipe submersion in several locations.

The entire neighborhood of Poinciana Circle has poor VCP sewers that are recommended for lining. There are other miscellaneous areas where the VCP sewers recommended for lining to prevent further joint failure and cracking.

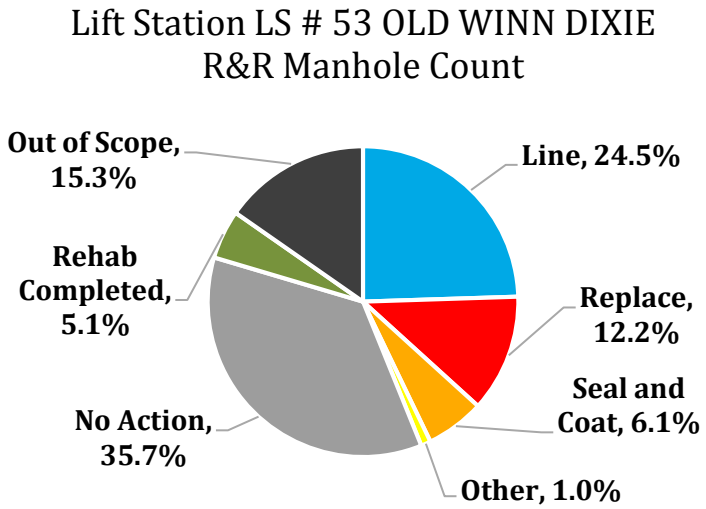
The chart below summarizes the recommendations for sewers in this area.



Manholes

The manholes in the area are brick with mortared walls. 24 of the manholes have missing mortar in joints and recommended to be lined There are 6 manholes that appear to be structurally sound, but have issues with infiltration and are recommended to be sealed and coated. There are a handful of manholes in the older area to be replaced due to condition and adjacent construction impacts.

The chart below summarizes the recommendations for the manholes in this area.



Out of Scope Assets

Inspection reports and videos were not provided for 3,611 feet (16%) of sewer and 15 (15%) manholes. There are several pockets of sewer along drainage areas where inspections were not completed, likely due to access across greenspace to the manholes. There was also a sewer that crosses the property of the Kissimmee Court Apartments that may have been inaccessible. The remaining uninspected assets are scattered throughout the area. It is recommended that the remaining inspections be completed prior to construction in the area.

Water Mains

Of the approximately 3,000 feet of sewer to be replaced, nearly half of it is located outside the roadway along easements adjacent to the drainage facilities in the area. 1,250 feet of 6 inch water main was identified for replacement in the Smith/Dolphin/Brack neighborhood, which includes replacing 410 feet of 2 inch main with 6 inch pipe.

Construction Considerations

The pipe recommended for replacement is found scattered throughout the lift station area and has overlap with numerous trenchless recommendations. If this area is set up for trenchless rehabilitation and open cut construction work to be bid as a separate projects, then the open cut construction project should be completed prior to the trenchless project.

Preliminary Construction Costs

Estimated bare construction costs to complete the rehabilitation recommended above can be seen in the table below.

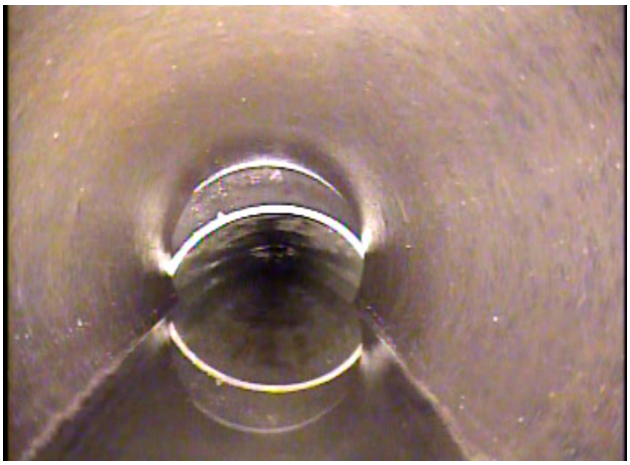
DESCRIPTION	ESTIMATED QUANTITIES	UNIT	UNIT PRICE ($)	COST ($)
Medium Cleaning Sanitary Sewer Mains (15" to 24" Diameter)	346	LF	$4.00	$1,384.00
Sanitary Sewer Main 8” Diameter (8' to 10' Depth)	2,691	LF	$65.00	$174,915.00
Sanitary Sewer Main 12” Diameter (8' to 10' Depth)	233	LF	$65.00	$15,145.00
Sanitary Manholes 4’ Diameter (8' to 10' Depth)	12	EA	$5,400.00	$64,800.00
Install/Repair/Replace 4" Sanitary Sewer Lateral (10' to 15' Depth @ Main)	58	EA	$2,610.00	$151,380.00
Seal and Recoat Manhole (48" Diameter)	48	VF	$300.00	$14,400.00
Fiberglass Manhole Insert (48" Diameter)	24	EA	$6,500.00	$156,000.00
Replace Inside Drop Connection	1	EA	$2,000.00	$2,000.00
Sanitary Sewer Main CIPP Liner (8" Diameter)	7,148	LF	$40.00	$285,920.00
Sanitary Sewer Main CIPP Liner (10" Diameter)	197	LF	$45.00	$8,865.00
Sanitary Sewer Main CIPP Liner (12" Diameter)	214	LF	$50.00	$10,700.00
FCLRL – CIPP Lateral Liner (6" Diameter, ≤30 LF)	1	EA	$2,745.00	$2,745.00
Sanitary Sewer Main Point Repair (6' to 10' Depth) (0 to 10 feet long) (Incl. Road Rest.)	7	EA	$10,000.00	$70,000.00
Sanitary Sewer Main Point Repair (10' to 15' Depth) (0 to 20 feet long) (Incl. Rd. Rest.)	3	EA	$15,000.00	$45,000.00
Milling and Resurfacing	3,899	SY	$11.00	$42,889.00
Asphalt Roadway Replacement (2"- 4" thick w/base)	3,249	SY	$45.00	$146,205.00
Water Main w/fittings & RJs (6" Diameter)	1,248	LF	$26.00	$32,448.00
Gate Valve with Box (6" Diameter)	3	EA	$1,150.00	$3,450.00
Fire Hydrant Assembly	2	EA	$3,230.00	$6,460.00
Water Service (short side)	13	EA	$650.00	$8,450.00
Water Service (long side)	13	EA	$1,125.00	$14,625.00
				$ 1,257,800.00

Estimated Trenchless Lining Construction Cost = $597,100
Estimated Open Cut Sewer Construction Cost = $595,300
Estimate Water Main Construction Cost = $65,400

3.1.19.2 Significant Snapshots:

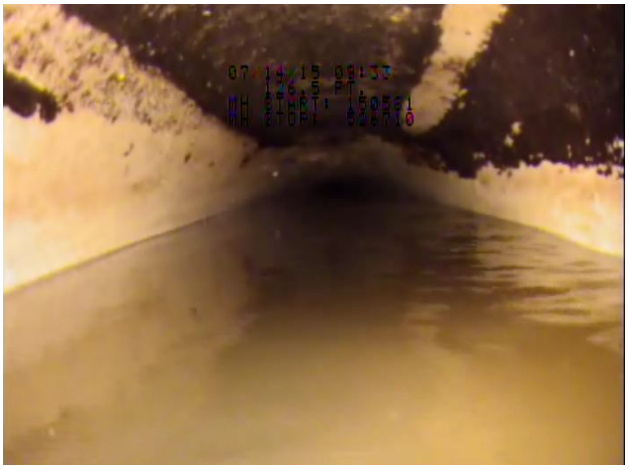
Several snapshots of defects found in the area are presented below.

Grease on Sagging Pipe Crown



Offset MMC

DIP Pipe Segment along Creek



PVC Pipe Sag under McLarin Circle

Hinge Fractures

3.1.20 LS # 55 Highland Plant

3.1.20.1 Recommendation Summary

Gravity Mains

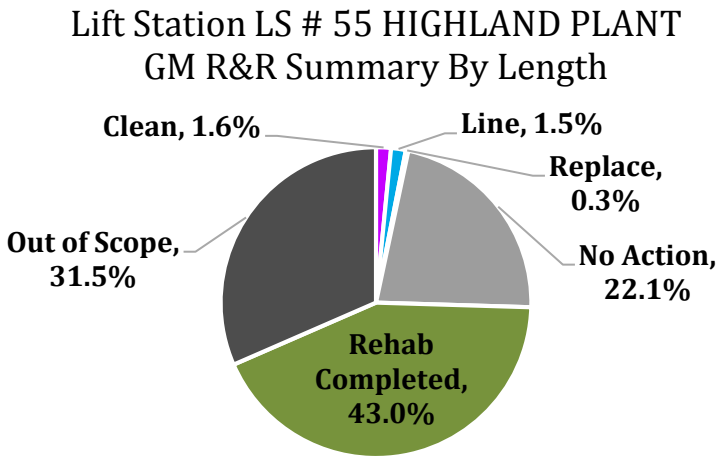
The gravity main piping in the Highland Plant lift station area is primarily PVC pipe. The PVC is in very good condition. A few reaches along Donegan Avenue contain minor sags.

The sewer in Highland Avenue, crossing Jackson Street and continuing up Milton Avenue has excessive grease attached to the walls and shows signs that the pipe runs full often. It appears that two separate force mains tie into this sewer, potentially running simultaneously and surcharging the pipe. It is recommended that these pipes are fully cleaned of grease, and that upstream measures be taken at the lift station tributary areas to reduce grease.

No full length replacement was identified during the review, however there were three locations where the pipe sagged into a downstream manhole, causing a full pipe sag. Two of these can be corrected under a short spot repair, with one pipe requiring approximately 55 feet of sewer be replaced to fix the problem.

There is one PVC pipe segment with a small hole chipped out that should be repaired with a short spot liner.

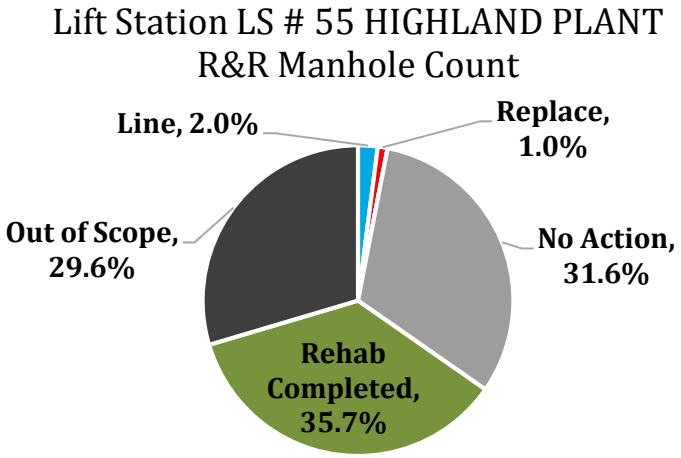
The chart below summarizes the recommendations for sewers in this area.



Manholes

The manholes in the area are precast concrete. One manhole was exhibiting active infiltration through joints and pipe penetrations and should be sealed and coated. The one manhole to be replaced is actually the installation of a new manhole at the end of an existing sewer, currently terminating at a plug, to provide upstream pipe access for cleaning or future rehabilitation.

The chart below summarizes the recommendations for the manholes in this area.



Out of Scope Assets

Inspection reports and videos were not provided for 6,511 feet (32%) of sewer and 29 (30%) manholes. There are two large sections of the system that were not inspected, including the piping and manholes in the Kissimmee Gardens Mobile Home Park and on the Highlands Elementary school campus. The other segments of sewer and manholes to be inspected are scattered across the area. Considering the amount of sewers and manholes not inspected, and unless these two areas are not under the jurisdiction of TWA, it is recommended that the remaining inspections be completed prior to construction.

Water Mains

There are no sewers being replaced in this area, therefore no water mains were included for replacement.

Construction Considerations

The open cut construction work includes two manhole replacements and a 55 foot long partial sewer replacement. Due to the small amount of open cut work to be completed, it is recommended to include the open cut work with the trenchless work under the same contract.

Preliminary Construction Costs

Estimated construction costs to complete the rehabilitation recommended above can be seen in the table below.

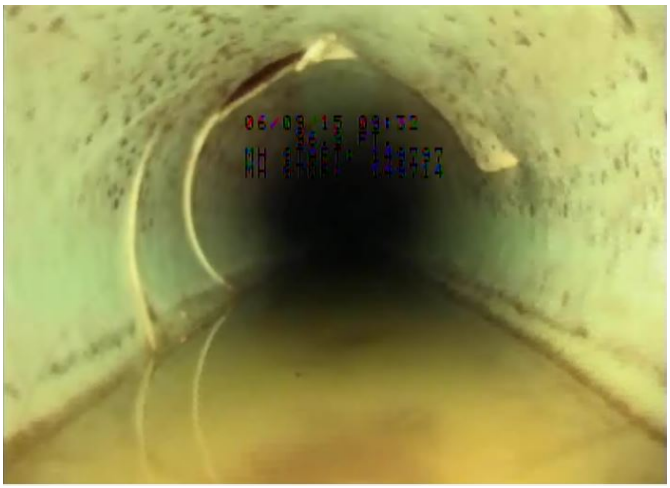
DESCRIPTION	ESTIMATED QUANTITIES	UNIT	UNIT PRICE ($)	COST ($)
Medium Cleaning Sanitary Sewer Mains (8" to 12" Diameter)	321	LF	$2.00	$642.00
Sanitary Sewer Main 8” Diameter (6' to 8' Depth)	55	LF	$60.00	$3,300.00
Seal and Recoat Manhole (48" Diameter)	1	EA	$5,400.00	$5,400.00
Install/Repair/Replace 4" Sanitary Sewer Lateral (10' to 15' Depth @ Main)	2	EA	$6,500.00	$13,000.00
Sanitary Sewer Main CIPP Liner (8" Diameter)	1	EA	$2,610.00	$2,610.00
Sanitary Sewer Main CIPP Liner (10" Diameter)	258	LF	$40.00	$10,320.00
Sanitary Sewer Main CIPP Liner (24" Diameter)	236	LF	$45.00	$10,620.00
Sanitary Sewer Main Point Repair (6' to 10' Depth) (0 to 10 feet long) (Incl. Road Rest.)	79	LF	$70.00	$5,530.00
CIPP Point Repair, 8" Diameter Sanitary Sewer Main	2	EA	$10,000.00	$20,000.00
Milling and Resurfacing	73	SY	$11.00	$803.00
Asphalt Roadway Replacement (2" to 4" thick w/base)	61	SY	$45.00	$2,745.00
				$ 75,000.00

Estimated Trenchless Lining Construction Cost = $60,100

Estimated Open Cut Sewer Construction Cost = $14,900

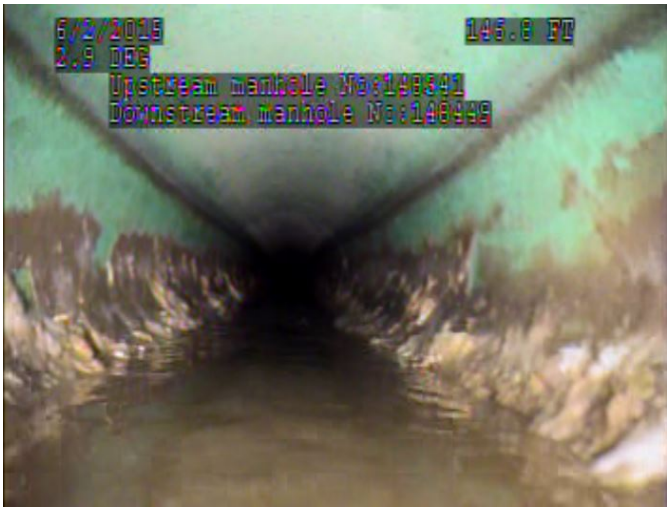
3.1.20.2 Significant Snapshots:

Several snapshots of defects found in the area are presented below.



Hole in PVC Pipe Crown

Fractured Manhole Wall



Attached Grease

PVC Pipe Sag into Manhole

3.1.21 LS # 57 Martin Street

3.1.21.1 Recommendation Summary

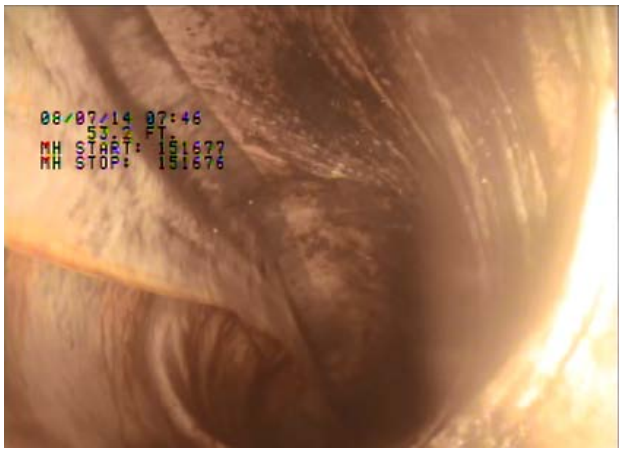
Gravity Mains

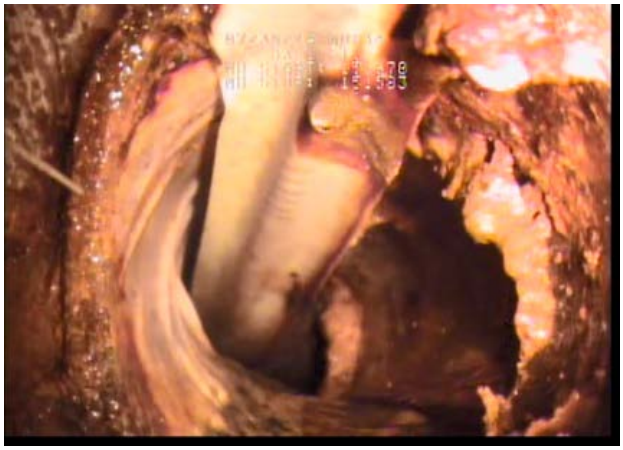
The Martin Street Lift Station area is the largest area reviewed, consisting of 143,784 feet of gravity main and 579 manholes. The system is located in the downtown area, west of the Lake Front Lift Station area, and shares many of the same characteristics including older areas with VCP and concrete pipes and brick manholes as well as newer and reconstructed areas that have PVC pipes and precast manholes.

As with Lake Front, some of the pipe assets in this area were broken up into multiple line segments for the same manhole to manhole reach of sewer. We suggest that whole pipes are provided a unique ID, and that individual segments be isolated by separate, but related IDs to allow for smooth sorting in the future. This was one of the factors inflating the amount of uninspected sewer.

There are several areas that had trenchless rehabilitation work previously completed. Areas that had rehabilitation completed or scheduled after the inspection phase typically were not included in the recommendation discussions. However in this area there were some peculiar defects on lateral liners in the area between Cecile Street and Virginia Drive. The picture below show there is a plastic seam from the liner that is loose in many cases and causing ragging of solids coming from the leads. It is uncertain as to what manufacturer product these lateral liners are, but we recommend researching this observation with the liner producer to see if it is a progressive failure or if it is cosmetic in nature. If this is an indication that these liners may be failing, it is suggested to perform rehabilitation to correct the problems, either through removal and replacement of the liners or through open cut replacement.

Lateral Liner Observations





There are approximately 19 segments of sewer that are recommended for cleaning. Cleaning is only recommended when the pipe is exhibiting signs that the flow is being altered, or backing up due to soil, sediment, rocks, construction debris, grease or roots. Several of these sewers could not be fully inspected due to the camera being blocked. These sewers should be cleaned and fully inspected to identify any defects or the source of the blockages. Medium or heavy cleaning should be specified to ensure full removal of all roots, grease, and other debris.

75 individual pipe segments are recommended to be lined, totaling 15,322 feet. Sewers to be lined were nearly all VCP, with some sewers including partial lengths of PVC or DIP that will be lined through to strengthen repair joints. VCP pipe that was found to be holding shape, have positive slope with minor sagging, and decent lateral connections were identified as good candidates for lining. Approximately 39 laterals were identified for lining to correct issues with cracks, fractures and separating joints that could be cleanly rehabilitated without excavation.

This number includes budgeting for correcting lateral issues in the area that was previously rehabilitated. There were 10 spot liners recommended to repair pipelines with singular defects, typically at joints.

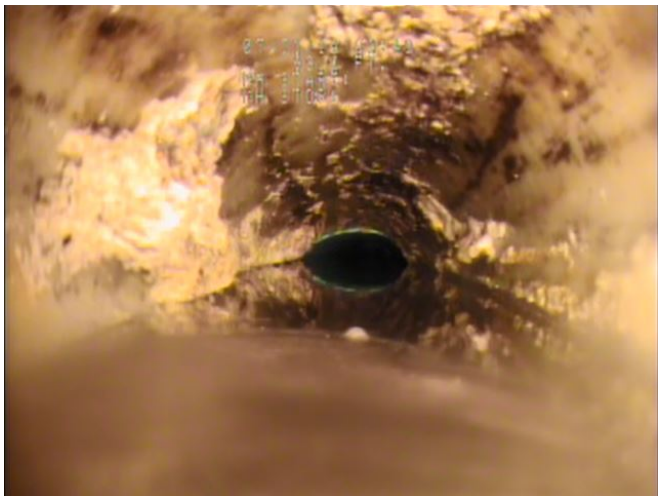
There are 20 spot repairs recommended throughout the project area. Spot repairs are called out to fix issues that cannot be corrected through lining alone. Defects such as sags, or offset joints can restrict the equipment used to perform trenchless rehabilitation and need to be corrected in advance of lining. In other cases, spot repairs may be performed to repair a lateral connection that cannot properly be accessed and repaired form the main, or to correct isolated defects on VCP or PVC sewers that are in otherwise good condition (i.e. utility cross-bores).

Utility Cross Bore Requiring Spot Repair

Pipes that required multiple spot repairs or excavations were evaluated for cost effectiveness versus full replacement. Similar repair costs estimates were evaluated to determine if the rehabilitation or replacement would provide a higher quality end product.

78 sewer segments totaling 19,272 feet are recommended to be replaced. Replacement work is located throughout the project area and typically consists of sewers that either have defects that cannot be feasibly repaired using trenchless methods or sewers with so many defects that the sum of all trenchless repairs would exceed the cost of open cut replacement. There were a handful of discreet areas where replacement is needed due to a particular recurring defect.

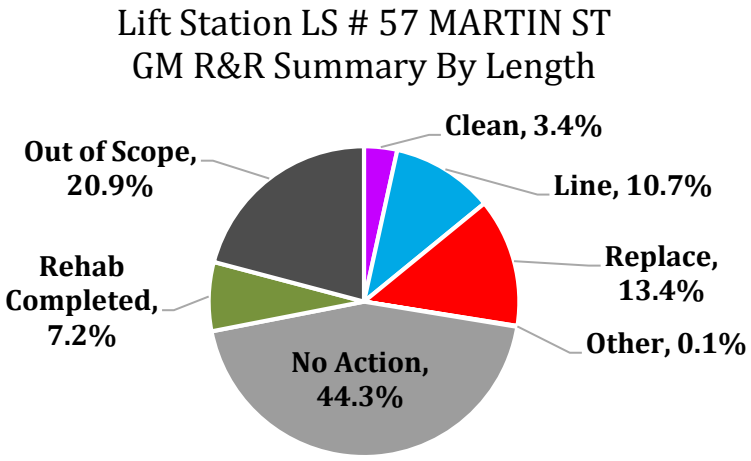
- W. Vine Street west of N. Thacker Avenue – VCP sewer along the south side of the road has large amounts of infiltration and defective lateral and joint connections. Infiltration includes several gushers of cloudy water, suggesting soil is infiltrating the system. These seers are recommended for replacement due to poor grade and poor lateral conditions.
- Neighborhood centered on roundabout at Oak and Phillip Streets – A number of sewers in this area have been lined in the past. Approximately 15 reaches of sewer in this area have significant remaining issues such as full-pipe sags causing hydraulic issues upstream, failed lateral connections beyond the liner cut-out and old pipe repairs that are offset and impassible. See the picture below for an example of the sagging on these previously lined sewers. Despite having been lined in the past, these pipes will continue to pose maintenance problems in the area and are recommended for repair.



Lined Pipe with Submerged Offset

- Several other areas included small clusters of sewers with major sagging and lateral connection problems. These defects are difficult to repair through using trenchless methods and are recommended for replacement.

The chart below summarizes the recommendations for sewers in this area.



Manholes

The manholes in the area are similar to the Lake Front area and include structures with brick and precast concrete walls. The manhole condition followed along with the condition of the sewers and rehabilitation recommendations considered the proposed pipe rehabilitation techniques.

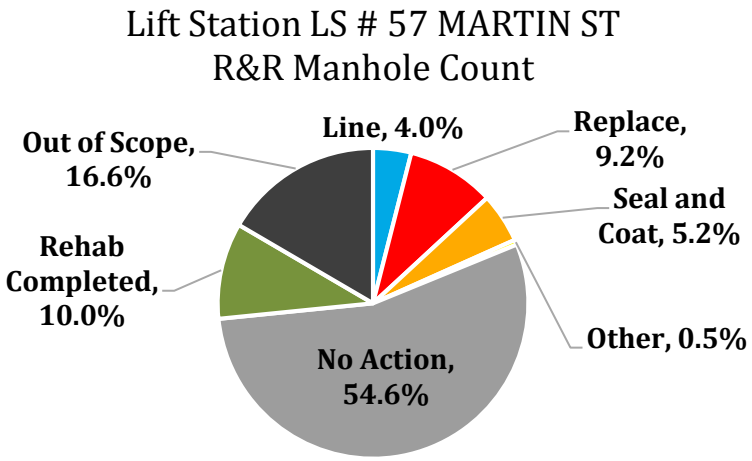
27 manholes in the area are recommended to be lined. These manholes are scattered throughout the area, generally following some of the sewer rehabilitation areas. If a manhole exhibited structural defects, then a liner was recommended.

30 manholes had notable infiltration, either at the chimney, walls or pipe penetrations but were free of structural defects and are recommended to be sealed and coated to halt further infiltration. These are found in clustered pockets near Vine Street, Thacker Avenue, Brown Street and Thacker Avenue where infiltration was observed flowing down the walls of the structures.

There were 3 manholes with brick benches that have begun to crumble and restrict flow. In these cases, it was recommended to reconstruct the manhole benching and flow channels.

51 manholes in the areas need to be replaced. A majority are found along reaches of sewer to be replaced and were it would not be feasible to remain in place during the sewer replacement. Other manholes are being replaced to correct settling and grade issues. There were also several manholes that are recommended for replacement due to irregularities including: missing or shearing bricks in manhole walls, extreme infiltration through brick joints, or to replace nonstandard manhole structures.

The chart below summarizes the recommendations for the manholes in this area.



Out of Scope Assets

Inspection reports and videos were not provided for 30,030 feet (21%) of sewer and 96 (17%) manhole. A number of these assets include sewers that were recently rehabilitated such as along John Young Parkway. A run of sewer along Clay Street (CSX ROW) and the drain between S. Palm Avenue and S. Latonia Street may not have been accessible. The entire sewer system on the Kissimmee Purchasing Department site was also left uninspected. Considering the amount of sewers and manholes not inspected, it is recommended that the remaining inspections be completed. Due to the size of this project, and the amount of sewer that has yet to be inspected, the work could be completed in phases, allowing TWA to complete the missing inspections.

Water Mains

There is 15,140 feet of water main that is either nonstandard size or material that is included for replacement. As noted with the Lake Front area, there are a few clustered sewer replacements that have some gaps between the replacement areas along the same street where it is recommended to replace the water main across the gaps. These areas should be further evaluated during detailed design to verify that the GIS attributes are correct and the proper recommendation were applied.

Construction Considerations

The Martin Street area is similar to Lake Front and includes significant sewer work spread across the entire area. The scope of an open cut replacement project would be complex and may have construction issues related to the spread between work zones, traffic control and detour impacts. Sequencing between open cut work and trenchless rehabilitation work may be difficult. It is recommended that this work be performed through several construction contracts.

Preliminary Construction Costs

Estimated bare construction costs to complete the rehabilitation recommended above can be seen in the table below.

DESCRIPTION	ESTIMATED QUANTITIES	UNIT	UNIT PRICE ($)	COST ($)
Medium Cleaning Sanitary Sewer Mains (8" to 12" Diameter)	3,511	LF	$2.00	$7,022.00
Medium Cleaning Sanitary Sewer Mains (15" to 24" Diameter)	1,445	LF	$4.00	$5,780.00
Sanitary Sewer Main 8” Diameter (8' to 10' Depth)	16,335	LF	$65.00	$1,061,775.00
Sanitary Sewer Main 10” Diameter (8' to 10' Depth)	2,004	LF	$85.00	$170,340.00
Sanitary Sewer Main 12” Diameter (8' to 10' Depth)	609	LF	$90.00	$54,810.00
Sanitary Sewer Main 20” Diameter (8' to 10' Depth)	51	EA	$5,400.00	$275,400.00
Sanitary Manholes 4’ Diameter (8' to 10' Depth)	300	VF	$300.00	$90,000.00
Seal and Recoat Manhole (48" Diameter)	27	EA	$6,500.00	$175,500.00
Fiberglass Manhole Insert (48" Diameter)	3	EA	$700.00	$2,100.00
Re-construct Manhole Benching	385	EA	$2,610.00	$1,004,850.00
Install/Repair/Replace 4" Sanitary Sewer Lateral (10' to 15' Depth @ Main)	12,259	LF	$40.00	$490,360.00
Sanitary Sewer Main CIPP Liner (8" Diameter)	796	LF	$45.00	$35,820.00
Sanitary Sewer Main CIPP Liner (10" Diameter)	1,514	LF	$50.00	$75,700.00
Sanitary Sewer Main CIPP Liner (12" Diameter)	753	LF	$55.00	$41,415.00
Sanitary Sewer Main CIPP Liner (15" Diameter)	39	EA	$2,745.00	$107,055.00
FCLRL – CIPP Lateral Liner (6" Diameter, ≤30 LF)	13	EA	$10,000.00	$130,000.00
Sanitary Sewer Main Point Repair (6' to 10' Depth) (0 -10 feet long) (Incl. Road Rest.)	7	EA	$15,000.00	$105,000.00

Estimated construction costs - continued

DESCRIPTION	ESTIMATED QUANTITIES	UNIT	UNIT PRICE ($)	COST ($)
Sanitary Sewer Main Point Repair (10' to 15' Depth) (0-20 feet long) (Incl. Rd. Rest.)	10	EA	$4,500.00	$45,000.00
CIPP Point Repair, 8" Diameter Sanitary Sewer Main	25,696	SY	$11.00	$282,656.00
Milling and Resurfacing	21,413	SY	$45.00	$963,585.00
Asphalt Roadway Replacement (2"- 4" thick w/base)	15,140	LF	$26.00	$393,640.00
Water Main w/fittings & RJs (6" Diameter)	224	LF	$28.00	$6,272.00
Water Main w/fittings & RJs (8" Diameter)	31	EA	$1,150.00	$35,650.00
Gate Valve with Box (6" Diameter)	1	EA	$1,450.00	$1,450.00
Gate Valve with Box (8" Diameter)	16	EA	$3,230.00	$51,680.00
Fire Hydrant Assembly	154	EA	$650.00	$100,100.00
Water Service (short side)	154	EA	$1,125.00	$173,250.00
Water Service (long side)	3,511	LF	$2.00	$7,022.00
				$5,931,600.00

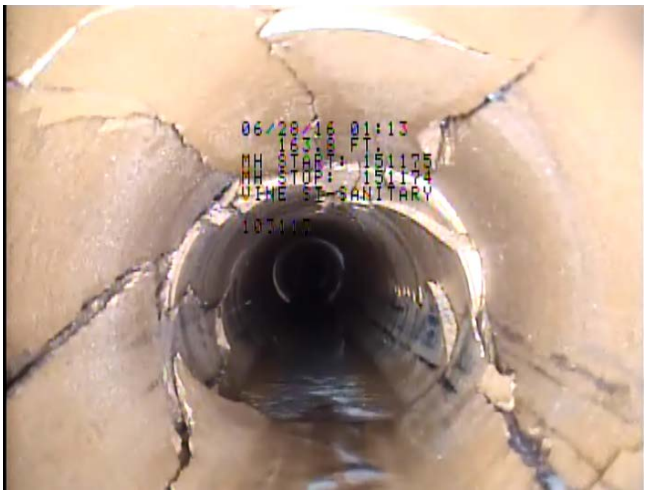
Estimated Trenchless Lining Construction Cost = $1,310,800

Estimated Open Cut Sewer Construction Cost = $3,858,700

Estimate Water Main Construction Cost = $762,100

3.1.21.2 Significant Snapshots:

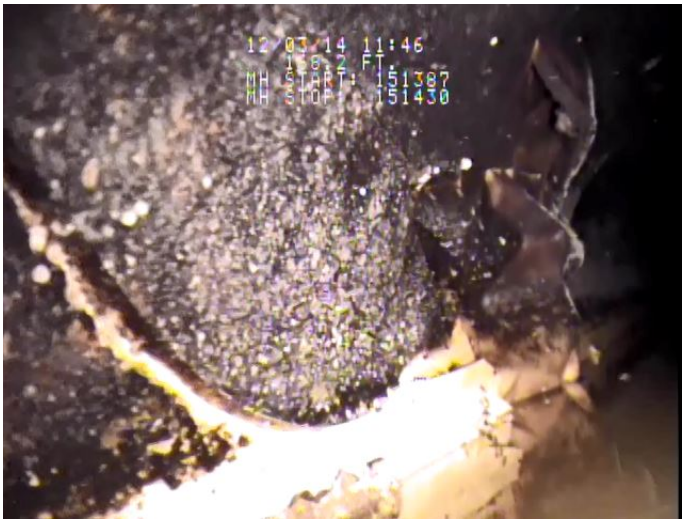
Several snapshots of defects found in the area are presented below.



Broken Pipe

Near Collapse

Brick Manhole Chimney



Utility Cross Bore in CIPP Lined Pipe

CI/DIP Pipe Section

Chimney Seal Flaking Away

Concrete Pipe Broken Wye

Sand Flowing into MH Channel with I/I

4.0 PROJECT IMPLEMENTATION

4.1 COST SUMMARY

The following opinion of construction costs reflects design and construction practices that comply with TWA Standards. Cost estimates include typical restoration requirements including pavement restoration of open cut trenches and full overlay of roads after sewer installation and sodding along water main construction. There are limitations to quantifying the work based on GIS data, as in some cases attribute information such as size, length or material may be incorrect. In order to capture some of this uncertainty, a construction cost contingency was added to the base project cost estimates. A contingency of 20% was applied for lining projects, while a contingency of 35% was applied to the open cut gravity main and water main replacement costs. These contingencies are anticipated to include typical mobilization and demobilization, bonds and permits, general requirement, utilities locates, erosion and sedimentation control, maintenance of traffic and sewer bypass costs. Table 4-1 summarizes preliminary estimates of construction costs for each area.

Table 4-1. Conceptual Project Cost Summary

TWA Sanitary Sewer Gravity Main R&R Summary				
Lift Station Area	**Rehab Construction Cost***	**Replace Construction Cost***	**Water Main Construction Cost***	**Total Construction Cost***
LS # 14 SAN REMO EAST	$545,600.00	$373,100.00	$102,700.00	$1,021,400.00
LS # 15 SAN REMO WEST	$431,700.00	$183,700.00	$89,700.00	$705,100.00
LS # 41 TROPHY LANE	$498,200.00	$8,100.00	$0.00	$506,300.00
LS # 42 COUNTRY CLUB ROAD	$766,400.00	$101,900.00	$30,200.00	$898,500.00
LS # 43 BOGIE	$466,000.00	$266,200.00	$108,200.00	$840,400.00
LS # 44 SCORE LANE	$381,300.00	$0.00	$0.00	$381,300.00
LS # 45 HAINES CITY ROAD	$830,600.00	$0.00	$0.00	$830,600.00
LS # 46 COYOTE ROAD	$247,500.00	$145,900.00	$0.00	$393,400.00
LS # 47 TIGER ROAD	$776,500.00	$466,200.00	$170,500.00	$1,413,200.00
LS # 54 NORTH FALCON	$270,800.00	$71,000.00	$56,900.00	$398,700.00
LS # 55 SOUTH FALCON	$79,000.00	$0.00	$0.00	$79,000.00
LS # 101 PINE ISLAND	$26,400.00	$0.00	$0.00	$26,400.00
LS # 102 ADMIRAL CT	$24,500.00	$0.00	$0.00	$24,500.00
LS # 33 OSCEOLA PARK	$311,200.00	$135,200.00	$0.00	$446,400.00
LS # 34 K & Y	$10,100.00	$0.00	$0.00	$10,100.00
LS # 35 LAKE FRONT	$2,014,400.00	$5,579,800.00	$1,389,300.00	$8,983,500.00
LS # 36 NEPTUNE POINT	$148,000.00	$384,700.00	$119,000.00	$651,700.00
LS # 45 JOHNSON PK	$269,600.00	$209,000.00	$56,600.00	$535,200.00
LS # 53 OLD WINN DIXIE	$788,200.00	$884,100.00	$97,200.00	$1,769,500.00
LS # 55 HIGHLAND PLANT	$79,400.00	$22,200.00	$0.00	$101,600.00
LS # 57 MARTIN ST	$1,730,300.00	$5,730,400.00	$1,131,800.00	$8,592,500.00
Sub-Total	$10,696,000.00	$14,562,000.00	$3,352,000.00	**$28,610,000.00**

*Blue highlighted rows indicate lift station areas that do not have any open cut replacement work.

4.2 PROJECT SCHEDULE AND CONSTRUCTION PHASING

Information regarding potential project delivery method is included in each of the individual lift station area summaries. This report outlines the different types of work to be done in each area regarding trenchless sewer rehabilitation, and open cut gravity and water main replacement. Three types of projects were identified:

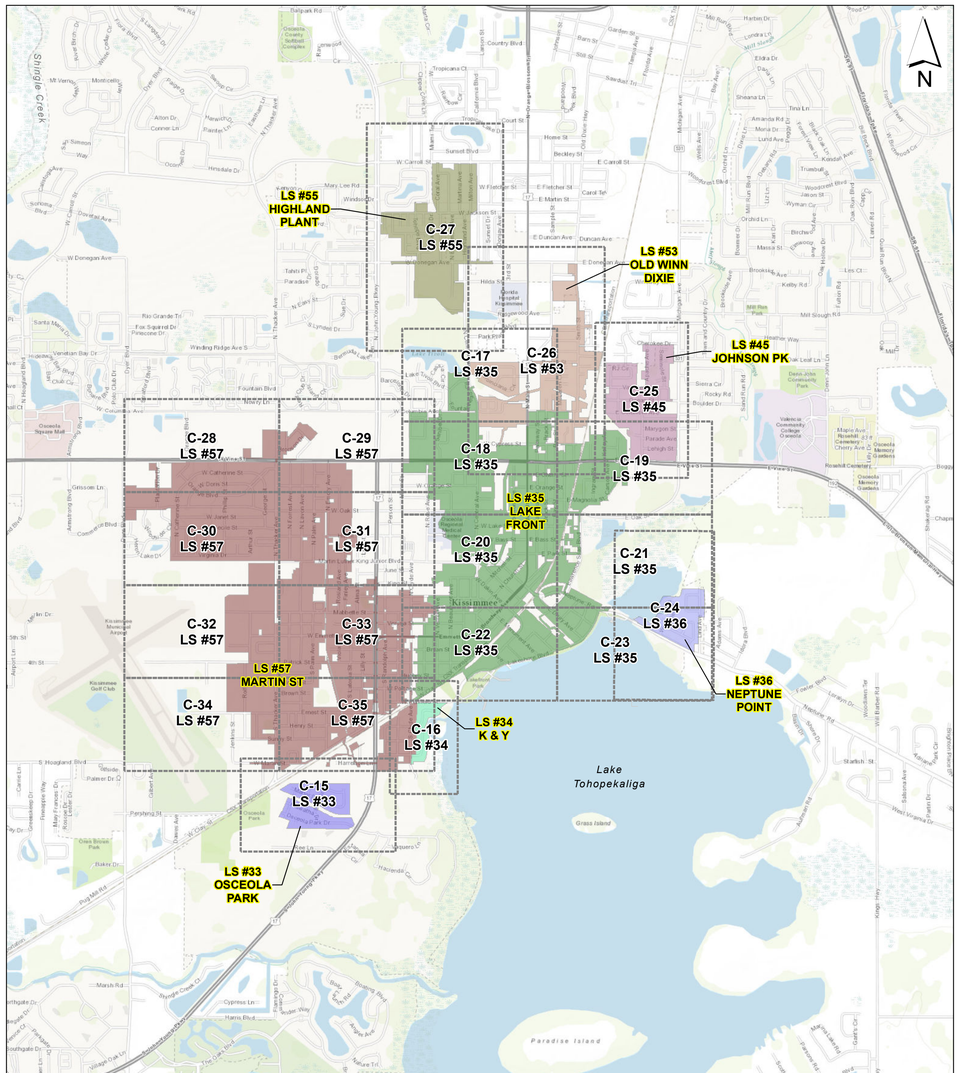
- **Trenchless projects** – these projects were based on the lift station areas where there were no full-reach sewer replacement recommendations or water main replacement work. The only excavation in these areas includes small spot repairs or manhole replacements and would not require a full site survey to bid the work. These projects could be packaged individually, or together in a larger trenchless rehabilitation project and bid for construction.
- **Integrated Improvement projects** – these projects include areas that have clear delineations between the open cut and trenchless work. These projects include some of both types of repair work, and may have specific sequencing issues that need to be included in the construction documents. There would be detailed design work for the replacement projects, requiring a full site survey for each replacement area and design of water main replacement that would push the anticipate bid and construction start times for these projects further into 2017 and 2018. There is potential to issue these projects as individual contracts, or to include multiple adjacent areas. Sizing of these projects would be up to schedule and proximity to other lift station areas. Where the rehabilitation work isn't constrained by the replacement work, it could be issued for bids immediately with other trenchless-only projects.
- **Complex Sewer and Water Improvement Projects** – The Martin Street and Lake Front areas are large downtown areas and present some specific challenges to defining distinct projects. Individual pockets of replacement with impact on rehabilitation work sequencing could be broken into smaller projects and isolated from other project work to allow specific replacement work to be completed in advance of trenchless rehabilitation project. There is also the potential to complete the survey and detailed design for the open cut replacement work throughout the entire area and include rehabilitation drawings with a detailed list of project sequencing constraints in the project specifications.

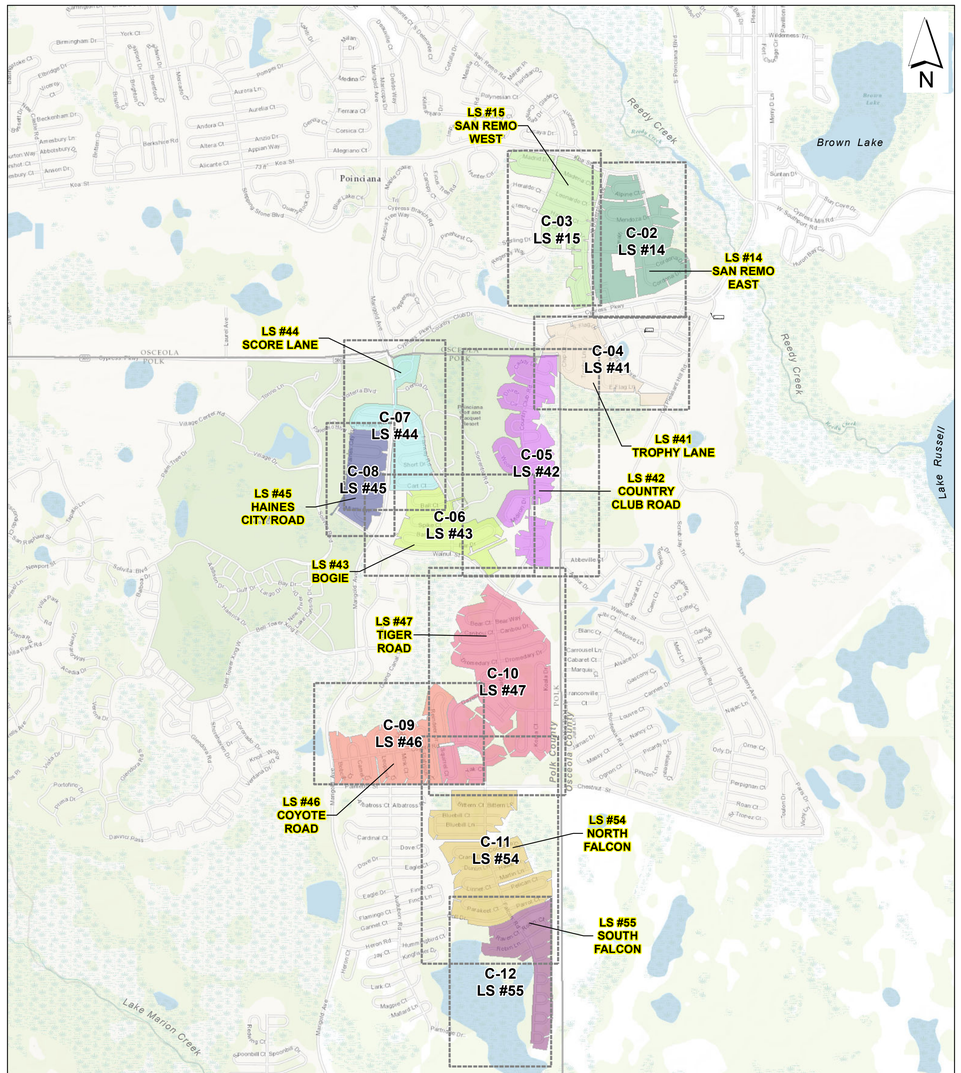
In the interest of moving forward with construction projects as quickly as possible, it was determined that the top two project types could proceed relatively soon due to a reduced design scope needed for trenchless work and minor spot repair construction. The work will be split into two sets of two projects as described below.

- **Lining Project** – Two sets of construction documents will be developed based on jurisdictional and geographical limits split between Downtown (Osceola County – Kissimmee and Unincorporated areas) and Poinciana (Polk County). The work will be entirely trenchless construction and include sewer cleaning, CIPP sewer and lateral lining, and manhole rehabilitation.
- **Spot Repair Project** – Two sets of construction documents will be developed based on the location of the spot repair and if it is located on a collector/primary roadway or within a residential subdivision. Due to the difference in permitting and design scope for spot repair work in collector/primary roads, those areas will be in a separate project. The other spot repair project will span both the Downtown and Poinciana areas.

APPENDICES

Appendix A:
Gravity Main and Manhole Recommendation Maps





SHEET	Lift Station Service Area	Scale
C-01	SHEET INDEX	1" = 2000"ft
C-02	LS # 14 SAN REMO EAST	1" = 150"ft
C-03	LS # 15 SAN REMO WEST	1" = 150"ft
C-04	LS # 41 TROPHY LANE	1" = 150"ft
C-05	LS # 42 COUNTRY CLUB ROAD	1" = 200"ft
C-06	LS # 43 BOGIE	1" = 150"ft
C-07	LS # 44 SCORE LANE	1" = 150"ft
C-08	LS # 45 HAINES CITY ROAD	1" = 100"ft
C-09	LS # 46 COYOTE ROAD	1" = 150"ft
C-10	LS # 47 TIGER ROAD	1" = 200"ft
C-11	LS # 54 NORTH FALCON	1" = 150"ft
C-12	LS # 55 SOUTH FALCON	1" = 150"ft
C-13	LS # 101 PINE ISLAND	1" = 100"ft
C-14	LS # 102 ADMIRAL CT	1" = 100"ft
C-15	LS # 33 OSCEOLA PARK	1" = 150"ft
C-16	LS # 34 K & Y	1" = 100"ft
C-17	LS # 35 LAKE FRONT	1" = 150"ft
C-18	LS # 35 LAKE FRONT	1" = 150"ft
C-19	LS # 35 LAKE FRONT	1" = 150"ft
C-20	LS # 35 LAKE FRONT	1" = 150"ft
C-21	LS # 35 LAKE FRONT	1" = 150"ft
C-22	LS # 35 LAKE FRONT	1" = 150"ft
C-23	LS # 35 LAKE FRONT	1" = 150"ft
C-24	LS # 36 NEPTUNE POINT	1" = 150"ft
C-25	LS # 45 JOHNSON PK	1" = 150"ft
C-26	LS # 53 OLD WINN DIXIE	1" = 200"ft
C-27	LS # 55 HIGHLAND PLANT	1" = 200"ft
C-28	LS # 57 MARTIN ST	1" = 150"ft
C-29	LS # 57 MARTIN ST	1" = 150"ft
C-30	LS # 57 MARTIN ST	1" = 150"ft
C-31	LS # 57 MARTIN ST	1" = 150"ft
C-32	LS # 57 MARTIN ST	1" = 150"ft
C-33	LS # 57 MARTIN ST	1" = 150"ft
C-34	LS # 57 MARTIN ST	1" = 150"ft
C-35	LS # 57 MARTIN ST	1" = 150"ft

Service Layer Credits: Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

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	4/21/2017	PDR Appendix A

TOHO WATER AUTHORITY
SHEET INDEX
GRAVITY SEWER REHABILITATION
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Project No.: 200-08466-16009
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Drawn By:
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C-01
Sheet 1 of 1

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Bar Measures 1 inch

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153927 (S)	Seal and Coat	153927	Asset Not In Scope	102094	Replace	102047	Asset Not In Scope
		153927	Maintenance Complete				Maintenance Complete

SR-0113 (A)	CIPP Spot Repair		Lift Station Service Area
SR-0125 (B)	Open Cut Spot Repair	LS	Existing Lift Stations
		EX FM	Existing Force Main

N

1 inch = 150 feet

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LS # 14 SAN REMO EAST
GRAVITY SEWER REHABILITATION

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LEGEND

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153927 S Seal and Coat	153927 Asset Not In Scope	102030 R Replace	102047 Asset Not In Scope		EX FM Existing Force Main
	153927 Maintenance Complete		Maintenance Complete		

N

1 inch = 150 feet

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LS # 15 SAN REMO WEST
GRAVITY SEWER REHABILITATION

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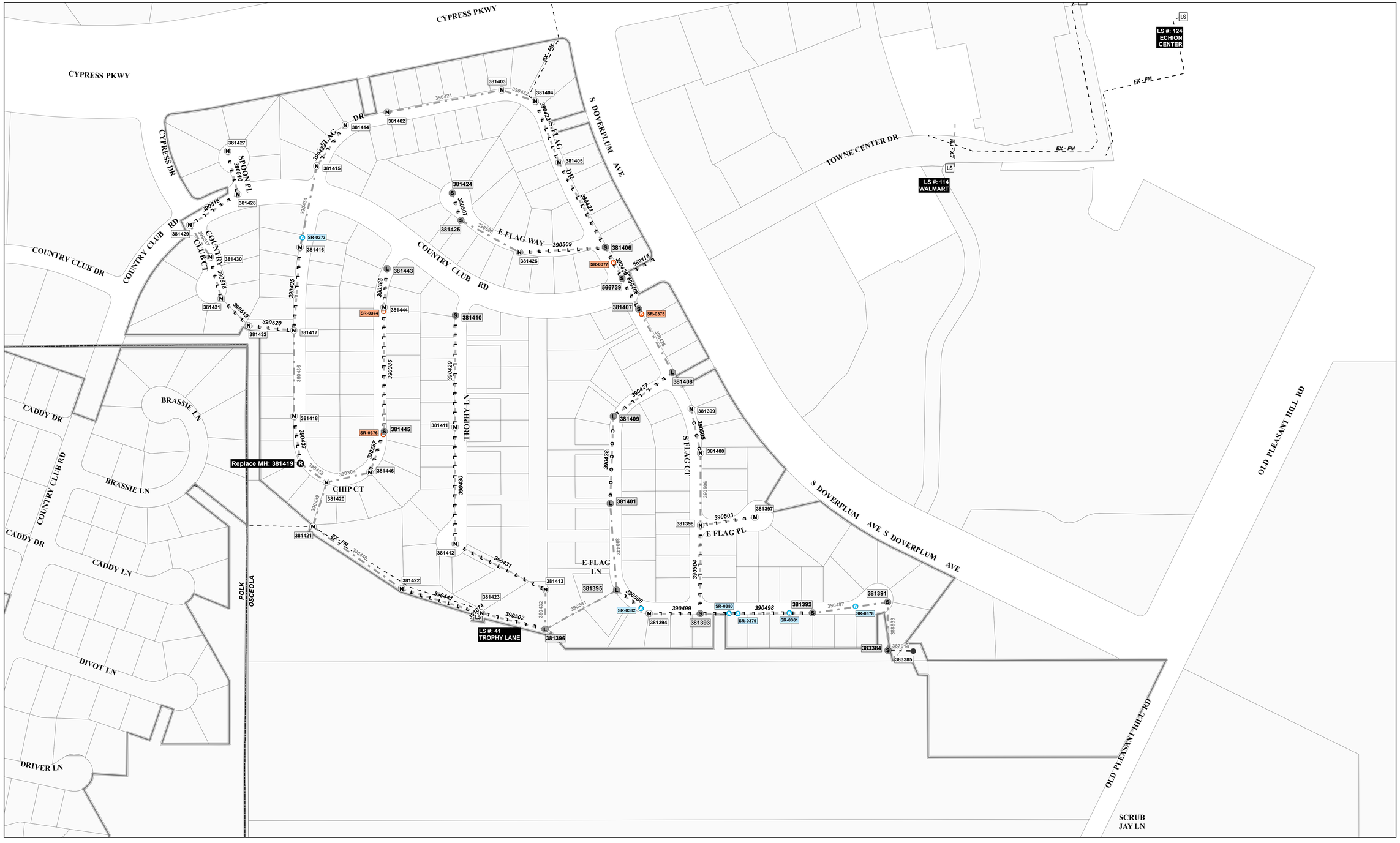

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153927 (S)	Seal and Coat	153927	Asset Not In Scope	102094 (R R R R)	Replace	102047	Asset Not In Scope
		153927	Maintenance Complete				Maintenance Complete

SR-0113 (A)	CIPP Spot Repair		Lift Station Service Area
SR-0125 (B)	Open Cut Spot Repair	LS	Existing Lift Stations
		EX FM	Existing Force Main

N

1 inch = 150 feet

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LS # 41 TROPHY LANE
GRAVITY SEWER REHABILITATION

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LEGEND

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153926 L Line	381453 N No Action	102055 Line	102109 No Action	SR-0125 B Open Cut Spot Repair	LS Existing Lift Stations
153927 S Seal and Coat	153927 Asset Not In Scope	102030 Replace	102047 Asset Not In Scope		EX FM Existing Force Main
	153927 Maintenance Complete		Maintenance Complete		

N

1 inch = 200 feet

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GRAVITY SEWER REHABILITATION

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		153927	Maintenance Complete				Maintenance Complete

SR-0113	CIPP Spot Repair
SR-0125	Open Cut Spot Repair
	Lift Station Service Area
LS	Existing Lift Stations
EX FM	Existing Force Main

N

1 inch = 150 feet

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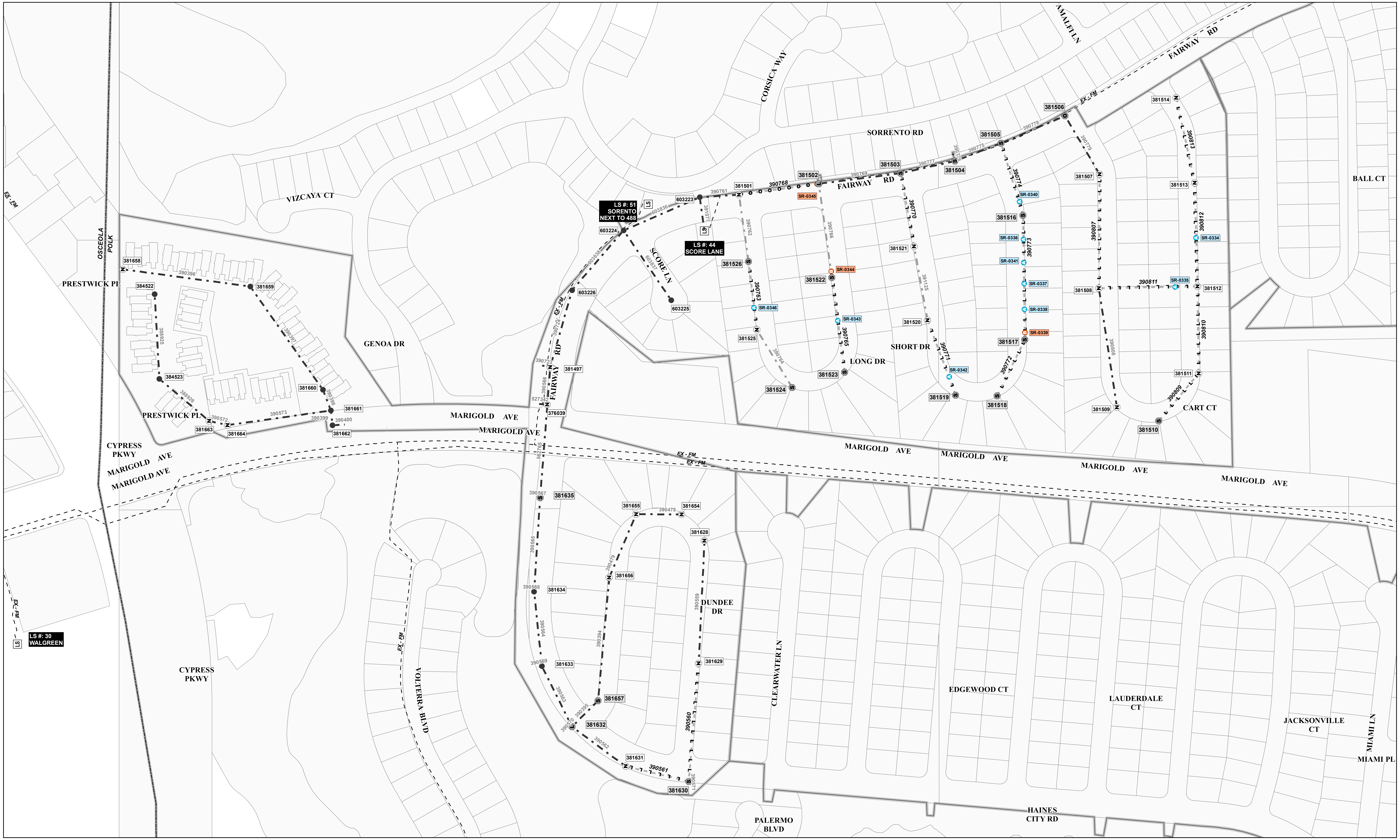

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153927	⊙	Maintenance Complete
105019	C	Clean
102055	L	Line
102054	R	Replace
390552	O	Other, Refer to Notes
102109		No Action
102047		Asset Not In Scope
		Maintenance Complete
SR-0113	A	CIPP Spot Repair
SR-0125	B	Open Cut Spot Repair
		Lift Station Service Area
	LS	Existing Lift Stations
	EX FM	Existing Force Main

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GRAVITY SEWER REHABILITATION

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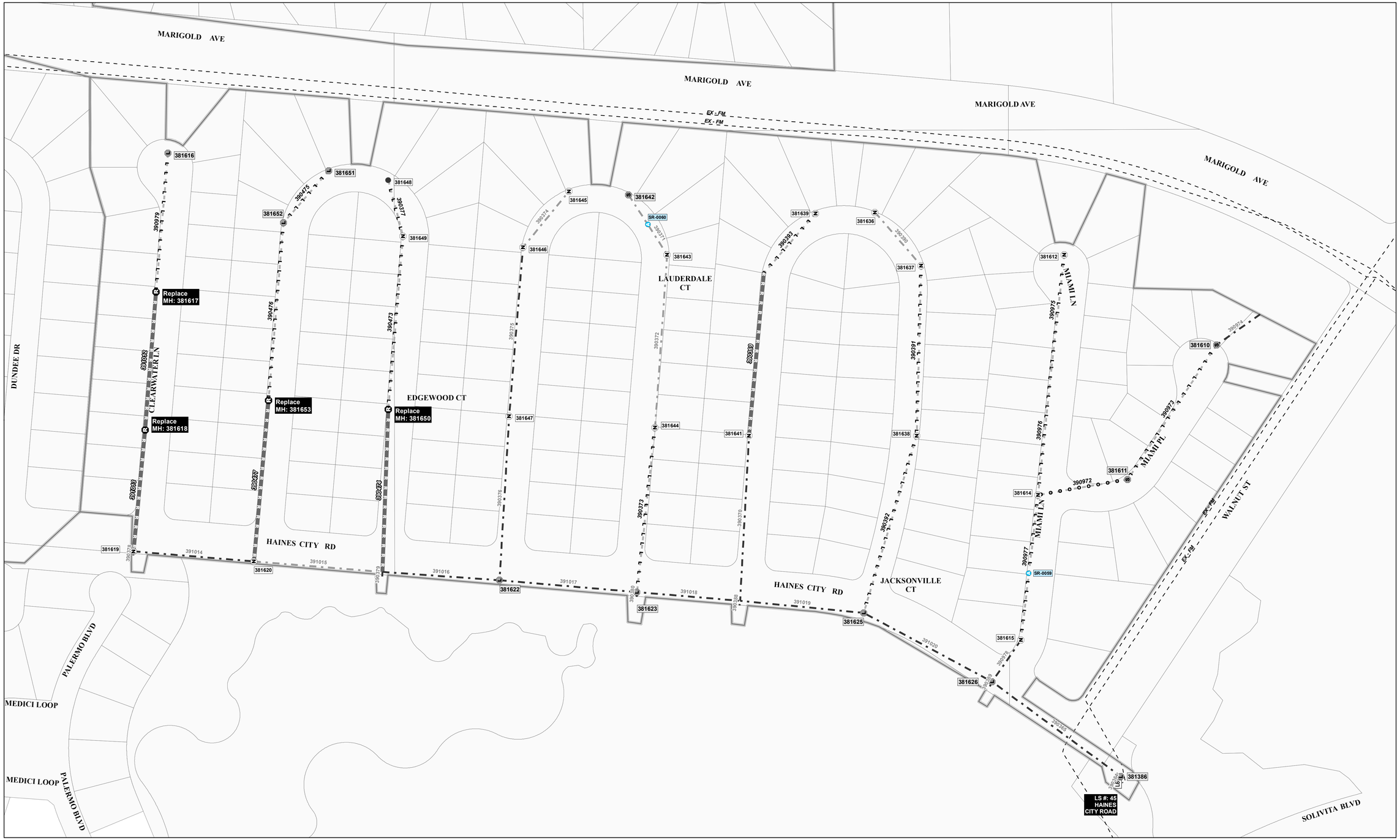

LEGEND

Replace MH: 381453 (R)	Replace	153926 (O)	Other, Refer to Notes	105019	Clean	390552	Other, Refer to Notes
153926 (L)	Line	381453 (N)	No Action	102055	Line	102109	No Action
153927 (S)	Seal and Coat	153927	Asset Not In Scope	102093	Replace	102047	Asset Not In Scope
		153927	Maintenance Complete				Maintenance Complete

SR-0113 (A)	CIPP Spot Repair		Lift Station Service Area
SR-0125 (B)	Open Cut Spot Repair	LS	Existing Lift Stations
		EX FM	Existing Force Main

N

1 inch = 100 feet

Bar Measures 1 inch

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TOHO WATER AUTHORITY
LS # 45 HAINES CITY ROAD
GRAVITY SEWER REHABILITATION

R/R GRAVITY PACKAGE NO 1

Project No.: 200-08466-16009
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LEGEND

Replace MH: 381453 (R)	Replace	105019 C - - C	Clean
153926 (L)	Line	102055 L L L	Line
153927 (S)	Seal and Coat	102054 R R R R	Replace
153926 (O)	Other, Refer to Notes	390552 O O O O	Other, Refer to Notes
381453 (N)	No Action	102109 — —	No Action
153927 ●	Asset Not In Scope	102047 — · —	Asset Not In Scope
153927 ⊙	Maintenance Complete	▬▬▬	Maintenance Complete
SR-0113 (A)	CIPP Spot Repair	▭	Lift Station Service Area
SR-0125 (B)	Open Cut Spot Repair	LS	Existing Lift Stations
		- - - EX FM	Existing Force Main

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TOHO WATER AUTHORITY
LS # 46 COYOTE ROAD
GRAVITY SEWER REHABILITATION

R/R GRAVITY PACKAGE NO 1

Project No.: 200-08466-16009
Designed By:
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Sheet 1 of 1

Bar Measures 1 inch

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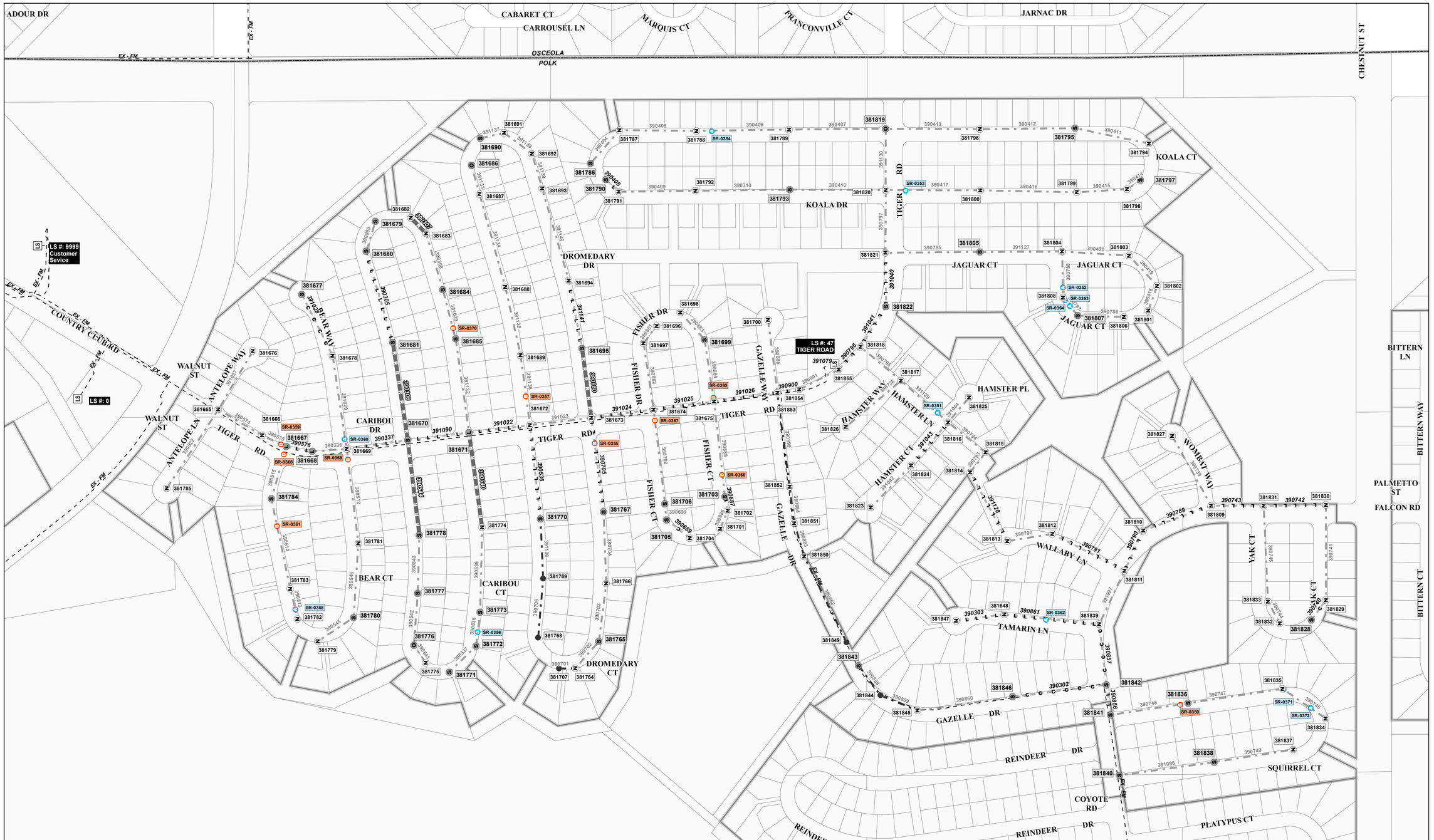

LEGEND

Replace MH: 381453 R	Replace	153926 O	Other, Refer to Notes	105019	Clean	390552	Other, Refer to Notes
153926 L	Line	381453 N	No Action	102055	Line	102109	No Action
153927 S	Seal and Coat	153927	Asset Not In Scope	102093	Replace	102047	Asset Not In Scope
		153927	Maintenance Complete				Maintenance Complete

SR-0113 A	CIPP Spot Repair		Lift Station Service Area
SR-0125 B	Open Cut Spot Repair	LS	Existing Lift Stations
		EX FM	Existing Force Main

1 inch = 200 feet

Bar Measures 1 inch

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TOHO WATER AUTHORITY
LS # 47 TIGER ROAD
GRAVITY SEWER REHABILITATION

R/R GRAVITY PACKAGE NO 1

Project No.: 200-08466-16009
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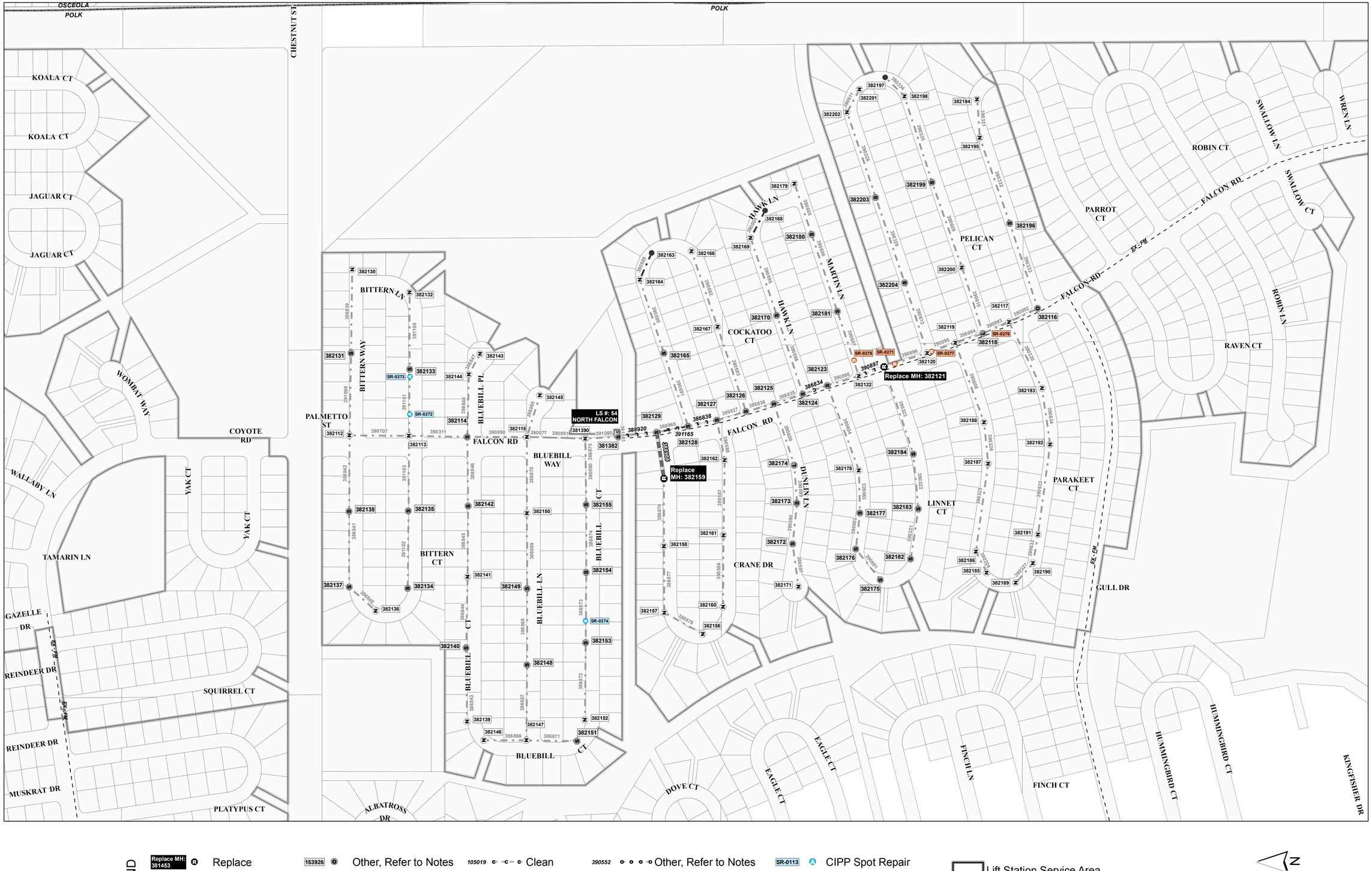

LEGEND

- Replace MH: 381453 (R) Replace
- 153926 (L) Line
- 153927 (S) Seal and Coat
- 153926 (O) Other, Refer to Notes
- 381453 (N) No Action
- 153927 Asset Not In Scope
- 153927 Maintenance Complete
- 105019 Clean
- 102055 Line
- 102093 Replace
- 390552 Other, Refer to Notes
- 102109 No Action
- 102047 Asset Not In Scope
- Maintenance Complete
- SR-0113 (A) CIPP Spot Repair
- SR-0125 (B) Open Cut Spot Repair
- Lift Station Service Area
- LS Existing Lift Stations
- EX FM Existing Force Main

N

1 inch = 200 feet

Bar Measures 1 inch

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TOHO WATER AUTHORITY
LS # 54 NORTH FALCON
GRAVITY SEWER REHABILITATION

R/R GRAVITY PACKAGE NO 1

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LEGEND

Replace MH: 381453	R	Replace
153926	L	Line
153927	S	Seal and Coat
153926	O	Other, Refer to Notes
381453	N	No Action
153927	●	Asset Not In Scope
153927	⊙	Maintenance Complete
105019	C	Clean
102055	L	Line
102054	R	Replace
390552	O	Other, Refer to Notes
102109		No Action
102047		Asset Not In Scope
		Maintenance Complete
SR-0113	A	CIPP Spot Repair
SR-0125	B	Open Cut Spot Repair
		Lift Station Service Area
	LS	Existing Lift Stations
	EX FM	Existing Force Main

N

1 inch = 150 feet

Bar Measures 1 inch

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TOHO WATER AUTHORITY
LS # 55 SOUTH FALCON
GRAVITY SEWER REHABILITATION

R/R GRAVITY PACKAGE NO 1

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LEGEND

Replace MH: 381453 Ⓡ Replace	153926 Other, Refer to Notes	105019 Clean	390552 Other, Refer to Notes
153926 Ⓛ Line	381453 Ⓝ No Action	102055 Line	102109 No Action
153927 Ⓢ Seal and Coat	153927 ● Asset Not In Scope	102054 Replace	102047 Asset Not In Scope
	153927 Maintenance Complete		Maintenance Complete

SR-0113 Ⓐ CIPP Spot Repair
SR-0125 Ⓑ Open Cut Spot Repair

Lift Station Service Area
LS Existing Lift Stations
EX FM Existing Force Main

N

1 inch = 100 feet

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TOHO WATER AUTHORITY
LS # 101 PINE ISLAND
GRAVITY SEWER REHABILITATION

R/R GRAVITY PACKAGE NO 1

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Bar Measures 1 inch

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LEGEND

Replace MH: 381453 R	Replace	153926 O	Other, Refer to Notes	105019 C	Clean	390552 O	Other, Refer to Notes
153926 L	Line	381453 N	No Action	102055 L	Line	102109 N	No Action
153927 S	Seal and Coat	153927	Asset Not In Scope	102094 R	Replace	102047	Asset Not In Scope
		153927	Maintenance Complete				Maintenance Complete

SR-0113 A	CIPP Spot Repair		Lift Station Service Area
SR-0125 B	Open Cut Spot Repair	LS	Existing Lift Stations
		EX FM	Existing Force Main

N

1 inch = 100 feet

Bar Measures 1 inch

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TOHO WATER AUTHORITY
LS # 102 ADMIRAL CT
GRAVITY SEWER REHABILITATION

R/R GRAVITY PACKAGE NO 1

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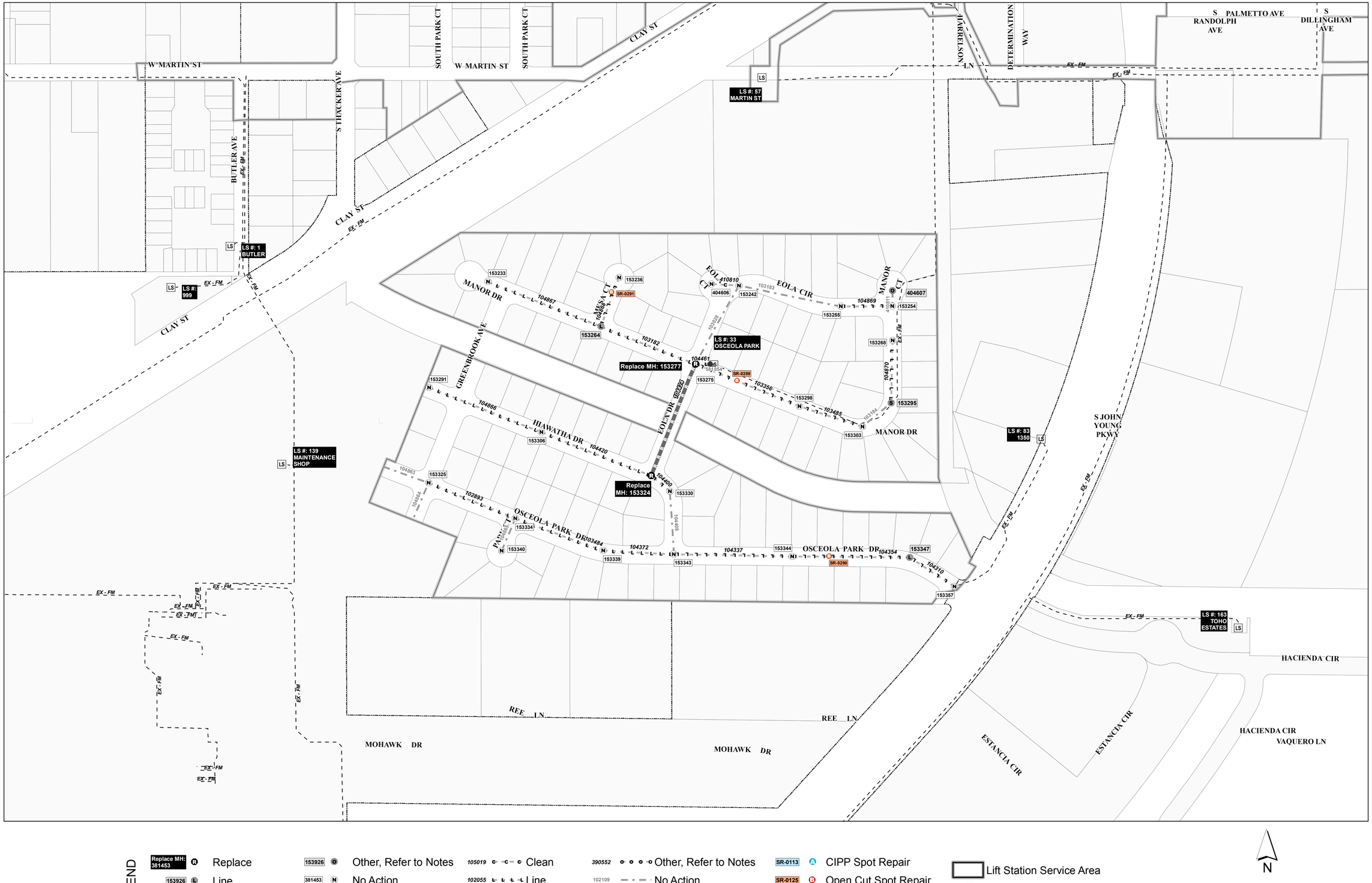

LEGEND

Replace MH: 381453 R Replace	153926 O Other, Refer to Notes	105019 C Clean	390552 Other, Refer to Notes	SR-0113 A CIPP Spot Repair	Lift Station Service Area
153926 L Line	381453 N No Action	102055 Line	102109 No Action	SR-0125 B Open Cut Spot Repair	LS Existing Lift Stations
153927 S Seal and Coat	153927 Asset Not In Scope	102093 Replace	102047 Asset Not In Scope		EX FM Existing Force Main
	153927 Maintenance Complete		Maintenance Complete		

N

1 inch = 150 feet

Bar Measures 1 inch

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TOHO WATER AUTHORITY
LS # 33 OSCEOLA PARK
GRAVITY SEWER REHABILITATION

R/R GRAVITY PACKAGE NO 1

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LEGEND

Replace MH: 381453 (R)	Replace	153926 (O)	Other, Refer to Notes	105019	Clean	390552	Other, Refer to Notes
153926 (L)	Line	381453 (N)	No Action	102055	Line	102109	No Action
153927 (S)	Seal and Coat	153927	Asset Not In Scope	102094	Replace	102047	Asset Not In Scope
		153927	Maintenance Complete				Maintenance Complete

SR-0113 (A)	CIPP Spot Repair		Lift Station Service Area
SR-0125 (B)	Open Cut Spot Repair	LS	Existing Lift Stations
		EX FM	Existing Force Main

N

1 inch = 100 feet

Bar Measures 1 inch

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LS # 34 K & Y
GRAVITY SEWER REHABILITATION

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LEGEND

Replace MH: 381453 R Replace	153926 O Other, Refer to Notes	105019 C Clean	390552 Other, Refer to Notes	SR-0113 A CIPP Spot Repair	Lift Station Service Area
153926 L Line	381453 N No Action	102055 L Line	102109 No Action	SR-0125 R Open Cut Spot Repair	LS Existing Lift Stations
153927 S Seal and Coat	153927 Asset Not In Scope	102034 R Replace	102047 Asset Not In Scope		EX FM Existing Force Main
	153927 Maintenance Complete		Maintenance Complete		

1 inch = 150 feet

Bar Measures 1 inch

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TOHO WATER AUTHORITY
LS # 35 LAKE FRONT
GRAVITY SEWER REHABILITATION

R/R GRAVITY PACKAGE NO 1

Project No.: 200-08466-16009
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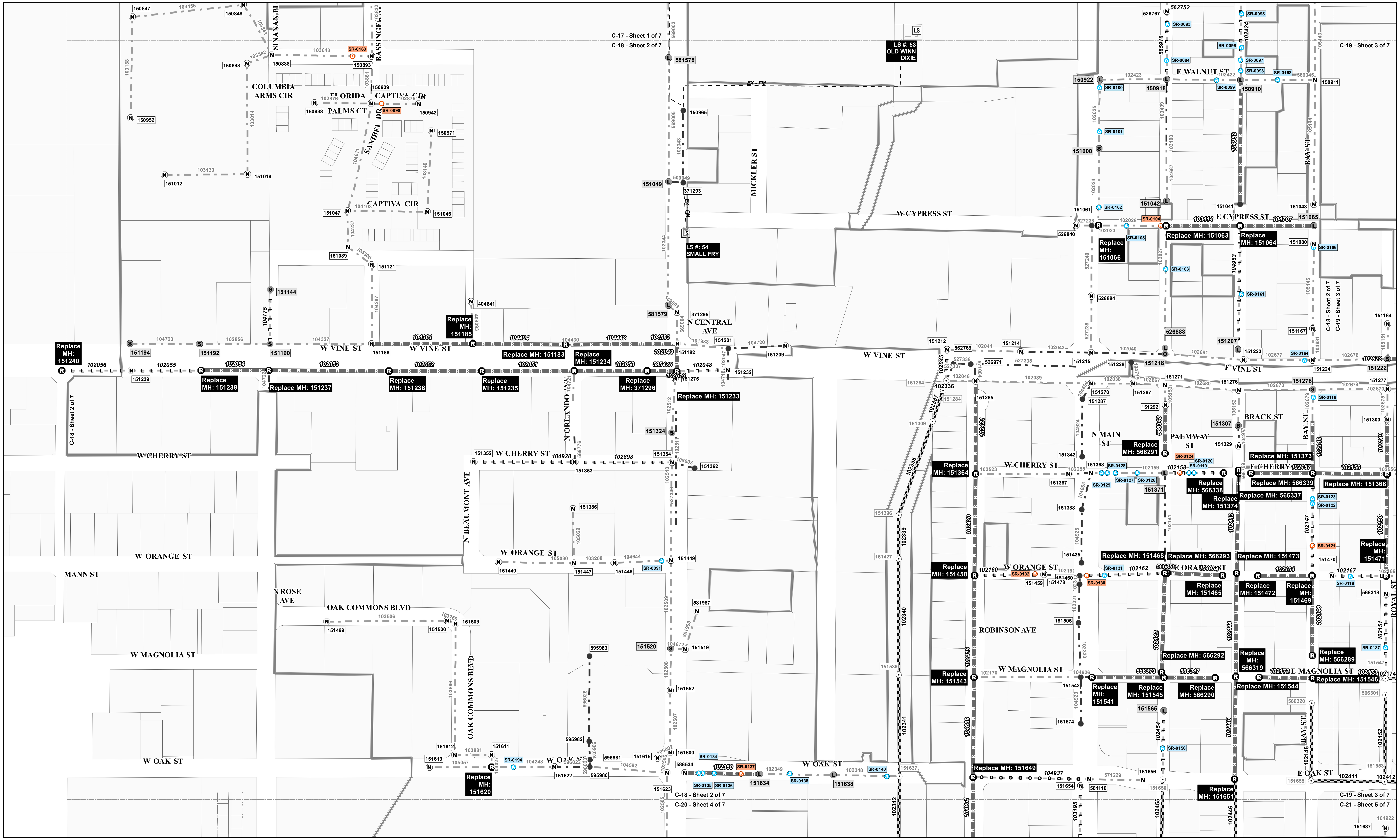

LEGEND

Replace MH: 381453 (R)	Replace	153926 (O)	Other, Refer to Notes
153926 (L)	Line	381453 (N)	No Action
153927 (S)	Seal and Coat	153927 ●	Asset Not In Scope
		153927 ⊙	Maintenance Complete

105019 C - C - C	Clean
102055 L - L - L	Line
102054 R R R R	Replace
390552 o o o o	Other, Refer to Notes
102109	No Action
102047	Asset Not In Scope
	Maintenance Complete
SR-0113 (A)	CIPP Spot Repair
SR-0125 (B)	Open Cut Spot Repair
	Lift Station Service Area
LS	Existing Lift Stations
EX FM	Existing Force Main

N

1 inch = 150 feet

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TOHO WATER AUTHORITY
LS # 35 LAKE FRONT
GRAVITY SEWER REHABILITATION

R/R GRAVITY PACKAGE NO 1

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Bar Measures 1 inch

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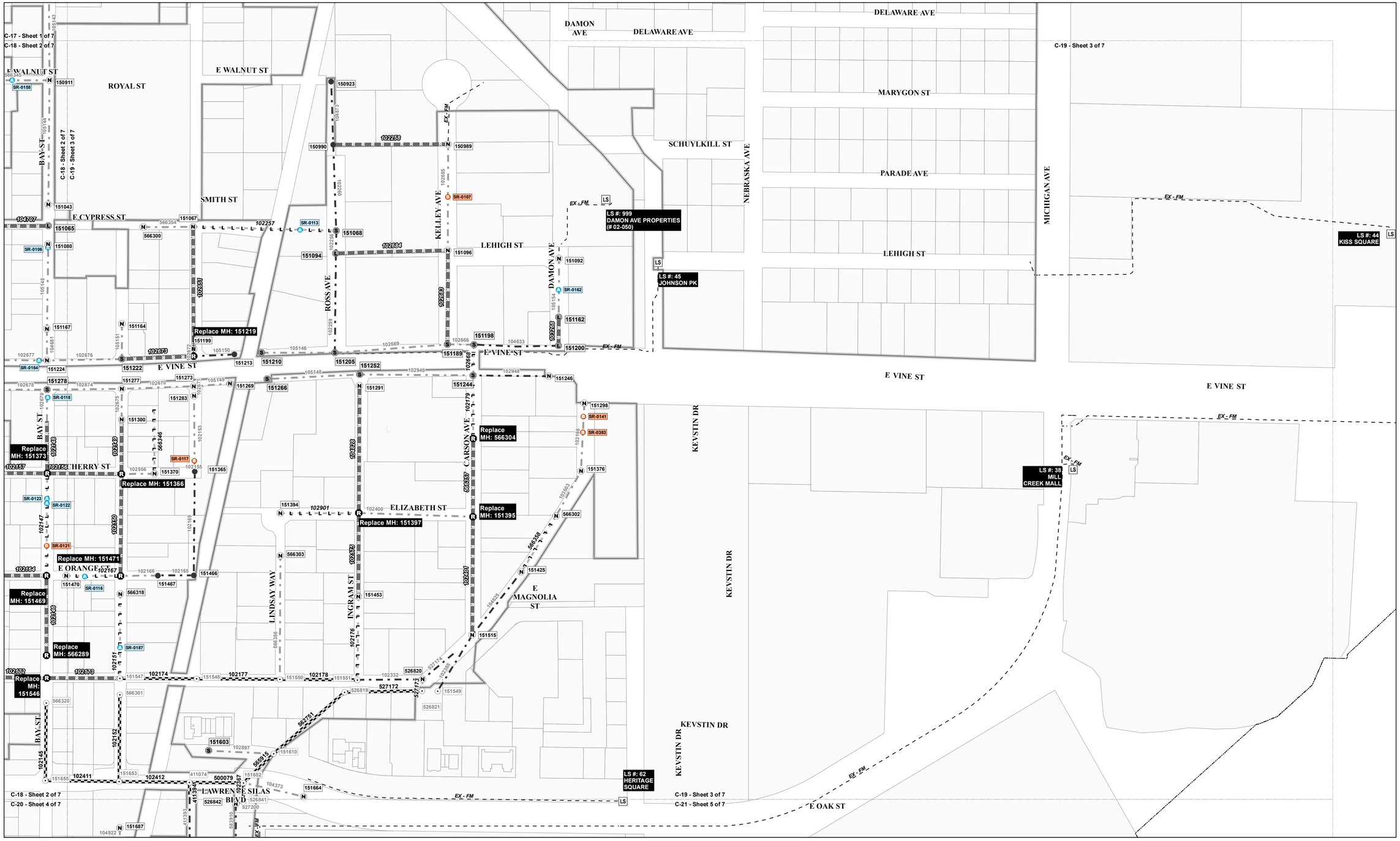

LEGEND

Replace MH: 381453 (R)	Replace	153926 (O)	Other, Refer to Notes	105019 (C)	Clean	390552 (O)	Other, Refer to Notes
153926 (L)	Line	381453 (N)	No Action	102055 (L)	Line	102109	No Action
153927 (S)	Seal and Coat	153927	Asset Not In Scope	102093 (R)	Replace	102047	Asset Not In Scope
		153927	Maintenance Complete				Maintenance Complete

SR-0113 (A)	CIPP Spot Repair		Lift Station Service Area
SR-0125 (B)	Open Cut Spot Repair	LS	Existing Lift Stations
		EX FM	Existing Force Main

N

1 inch = 150 feet

Bar Measures 1 inch

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LS # 35 LAKE FRONT
GRAVITY SEWER REHABILITATION

R/R GRAVITY PACKAGE NO 1

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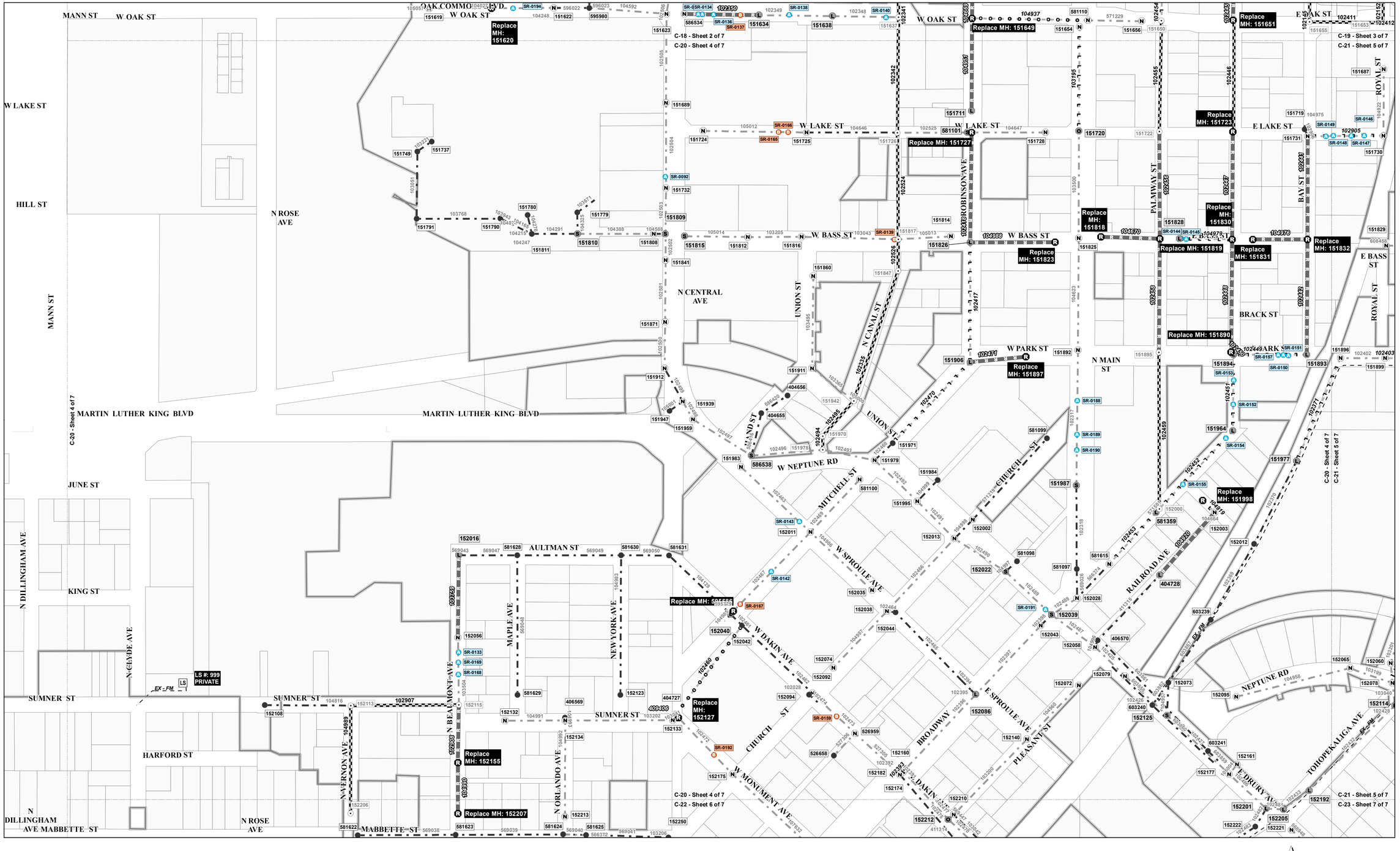

LEGEND

Replace MH: 381453 (R)	Replace	153926 (O)	Other, Refer to Notes	105019	Clean	390552	Other, Refer to Notes
153926 (L)	Line	381453 (N)	No Action	102055	Line	102109	No Action
153927 (S)	Seal and Coat	153927	Asset Not In Scope	102034	Replace	102047	Asset Not In Scope
		153927	Maintenance Complete				Maintenance Complete

SR-0113 (A) CIPP Spot Repair

SR-0125 (B) Open Cut Spot Repair

Lift Station Service Area

LS Existing Lift Stations

EX FM Existing Force Main

N

1 inch = 150 feet

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LS # 35 LAKE FRONT
GRAVITY SEWER REHABILITATION

R/R GRAVITY PACKAGE NO 1

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Bar Measures 1 inch

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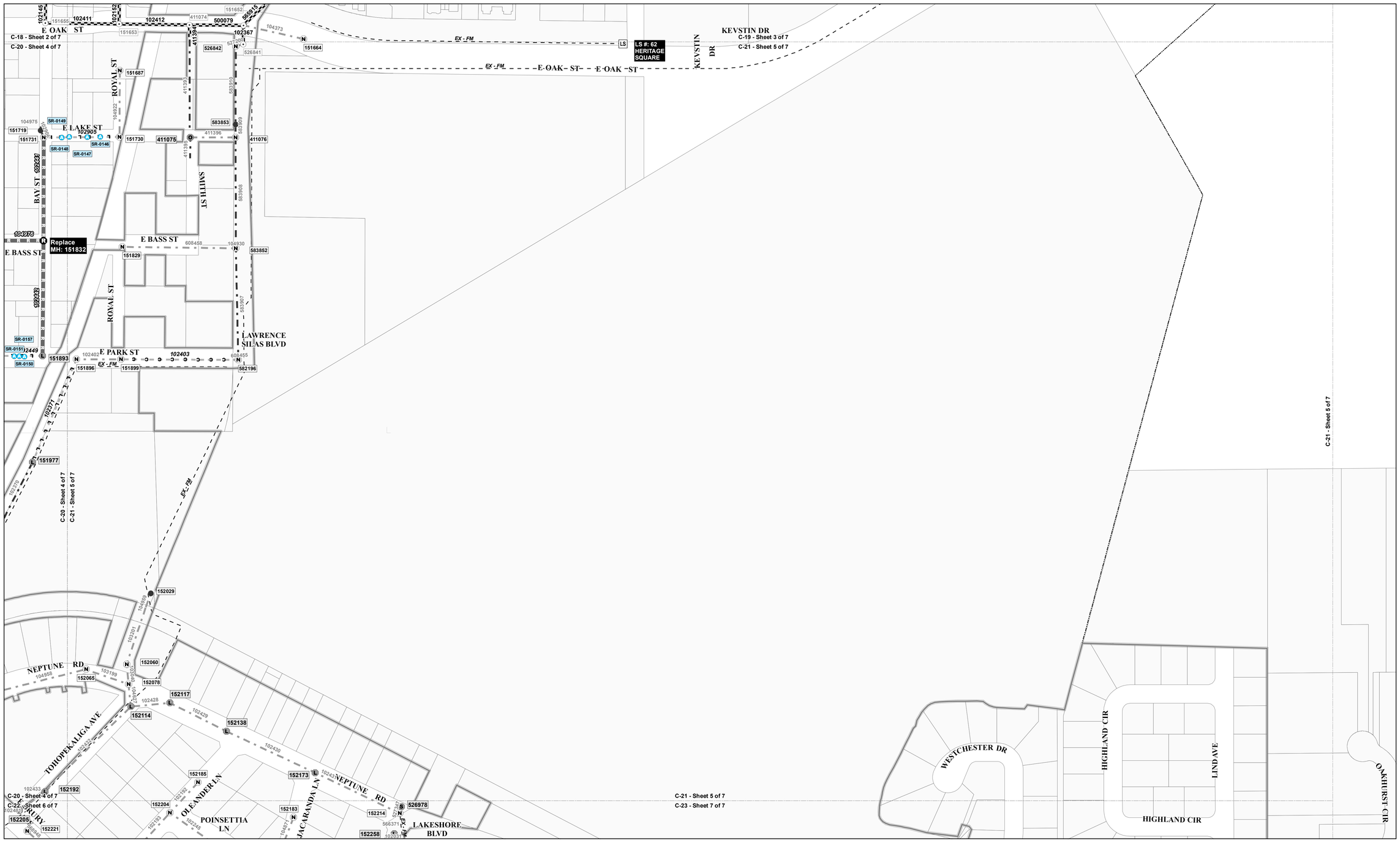

LEGEND

Replace MH: 381453	R Replace	153926	O Other, Refer to Notes	105019	Clean	390552	Other, Refer to Notes
153926	L Line	381453	N No Action	102055	Line	102109	No Action
153927	S Seal and Coat	153927	Asset Not In Scope	102030	Replace	102047	Asset Not In Scope
		153927	Maintenance Complete				Maintenance Complete

SR-0113	A	CIPP Spot Repair	Lift Station Service Area
SR-0125	B	Open Cut Spot Repair	LS Existing Lift Stations
			EX FM Existing Force Main

N

1 inch = 150 feet

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TOHO WATER AUTHORITY
LS # 35 LAKE FRONT
GRAVITY SEWER REHABILITATION
R/R GRAVITY PACKAGE NO 1

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Bar Measures 1 inch

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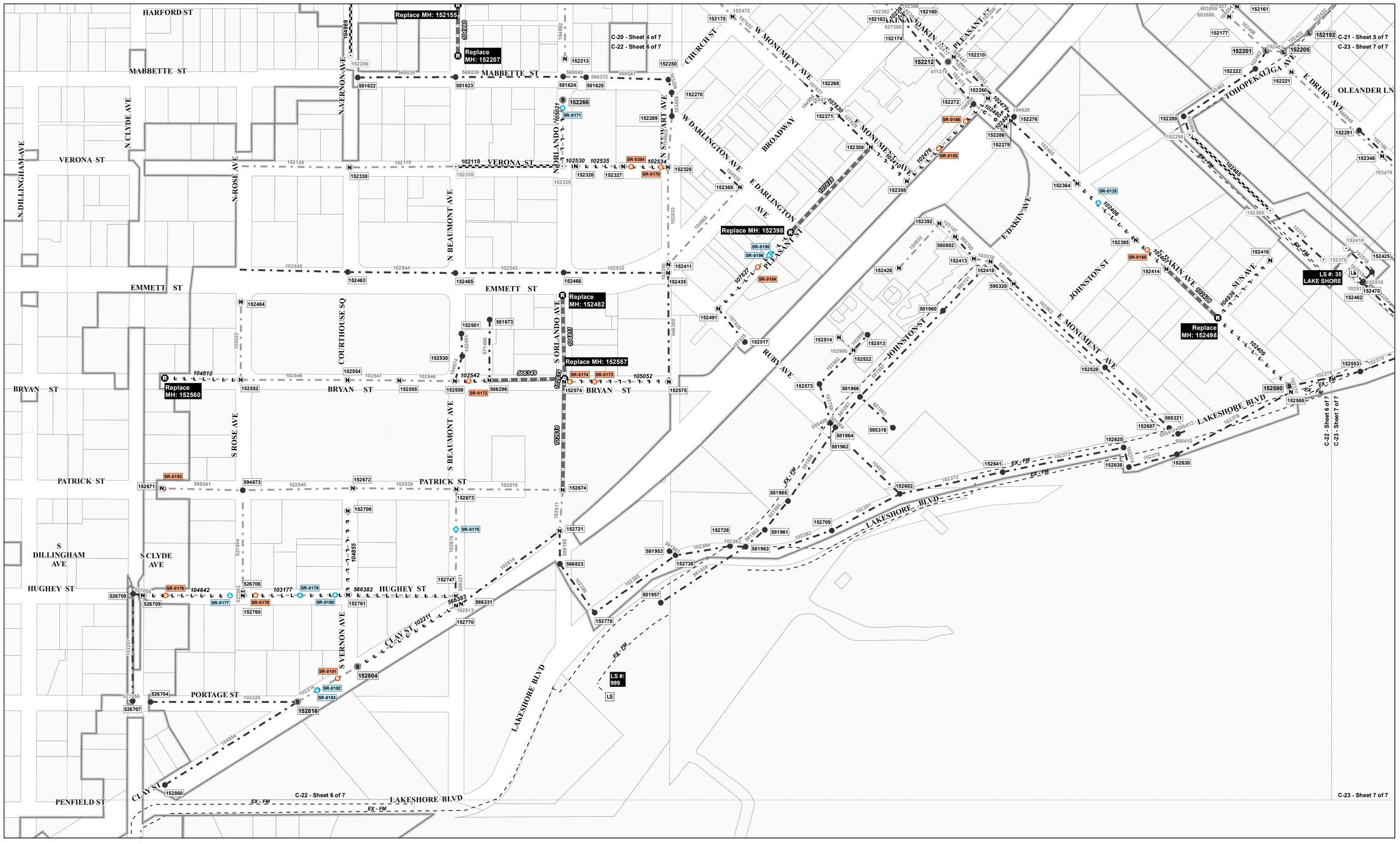

LEGEND

Replace MH: 381453 (R)	Replace	153926 (O)	Other, Refer to Notes	105019	Clean	390552	Other, Refer to Notes
153926 (L)	Line	381453 (N)	No Action	102055	Line	102109	No Action
153927 (S)	Seal and Coat	153927	Asset Not In Scope	102034	Replace	102047	Asset Not In Scope
		153927	Maintenance Complete				Maintenance Complete

SR-0113 (A)	CIPP Spot Repair		Lift Station Service Area
SR-0125 (B)	Open Cut Spot Repair	LS	Existing Lift Stations
		EX FM	Existing Force Main

N

1 inch = 150 feet

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TOHO WATER AUTHORITY
LS # 35 LAKE FRONT
GRAVITY SEWER REHABILITATION

R/R GRAVITY PACKAGE NO 1

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Bar Measures 1 inch

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LEGEND

Replace MH: 381453 (R)	Replace	153926 (O)	Other, Refer to Notes	105019	Clean	390552	Other, Refer to Notes
153926 (L)	Line	381453 (N)	No Action	102055	Line	102109	No Action
153927 (S)	Seal and Coat	153927	Asset Not In Scope	102093	Replace	102047	Asset Not In Scope
		153927	Maintenance Complete				Maintenance Complete

SR-0113 (A)	CIPP Spot Repair		Lift Station Service Area
SR-0125 (B)	Open Cut Spot Repair	LS	Existing Lift Stations
		EX FM	Existing Force Main

N

1 inch = 150 feet

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TOHO WATER AUTHORITY
LS # 35 LAKE FRONT
GRAVITY SEWER REHABILITATION

R/R GRAVITY PACKAGE NO 1

Project No.: 200-08466-16009
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Sheet 7 of 7

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Bar Measures 1 inch

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LEGEND

Replace MH: 381453	R	Replace
153926	L	Line
153927	S	Seal and Coat
153926	O	Other, Refer to Notes
381453	N	No Action
153927	●	Asset Not In Scope
153927	⊙	Maintenance Complete
105019	C	Clean
102055	L	Line
102054	R	Replace
390552	O	Other, Refer to Notes
102109		No Action
102047		Asset Not In Scope
		Maintenance Complete
SR-0113	A	CIPP Spot Repair
SR-0125	B	Open Cut Spot Repair
		Lift Station Service Area
	LS	Existing Lift Stations
	EX FM	Existing Force Main

N

1 inch = 150 feet

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TOHO WATER AUTHORITY
LS # 36 NEPTUNE POINT
GRAVITY SEWER REHABILITATION

R/R GRAVITY PACKAGE NO 1

Project No.: 200-08466-16009
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Sheet 1 of 1

Bar Measures 1 inch

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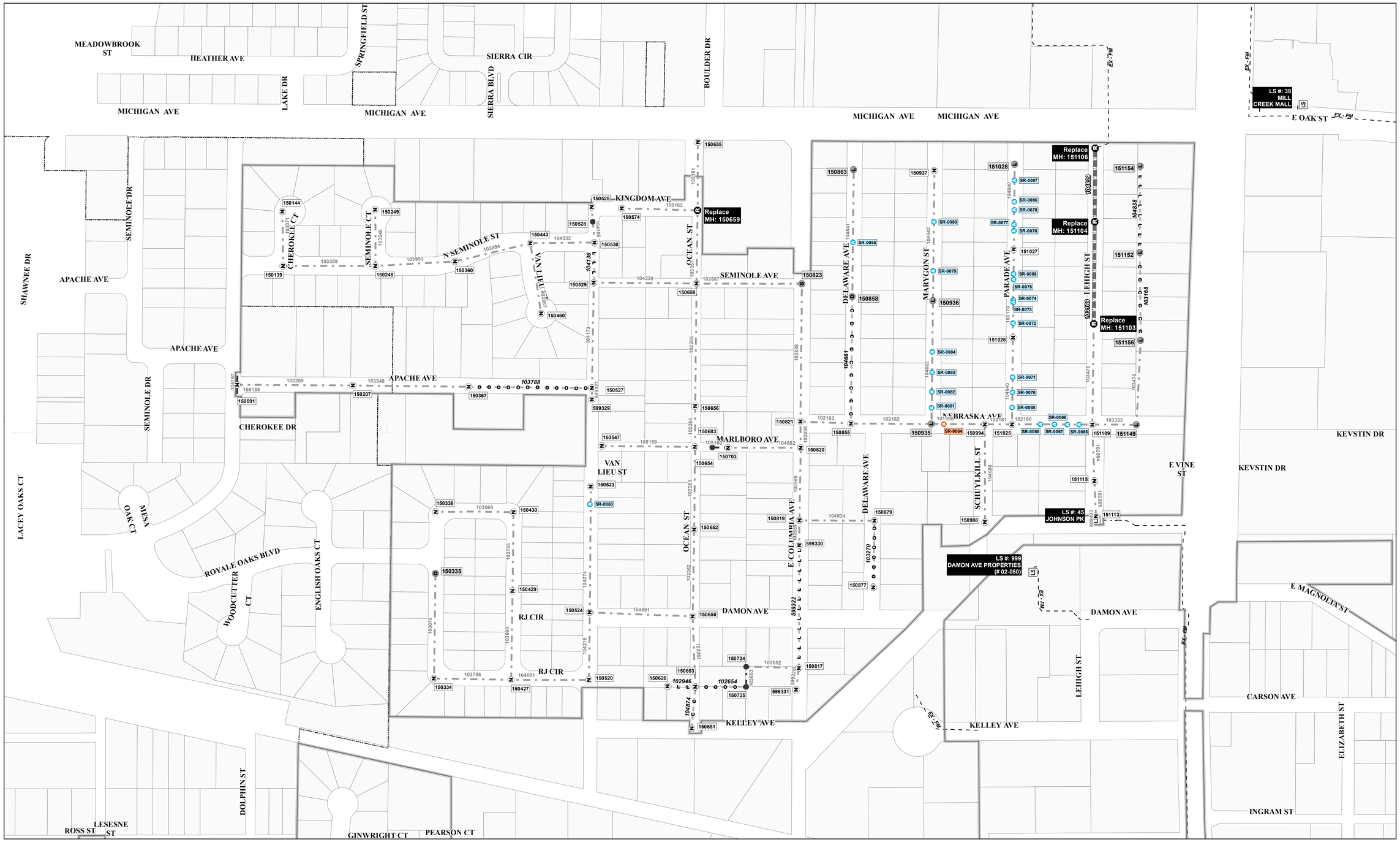

LEGEND

Replace MH: 381453 (R)	Replace	153926 (O)	Other, Refer to Notes	105019	Clean	390552	Other, Refer to Notes
153926 (L)	Line	381453 (N)	No Action	102055	Line	102109	No Action
153927 (S)	Seal and Coat	153927 (●)	Asset Not In Scope	102030	Replace	102047	Asset Not In Scope
		153927 (⊙)	Maintenance Complete				Maintenance Complete

SR-0113 (A) CIPP Spot Repair

SR-0125 (B) Open Cut Spot Repair

Lift Station Service Area

LS Existing Lift Stations

EX FM Existing Force Main

N

1 inch = 150 feet

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LS # 45 JOHNSON PK
GRAVITY SEWER REHABILITATION

R/R GRAVITY PACKAGE NO 1

Project No.: 200-08466-16009
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Bar Measures 1 inch

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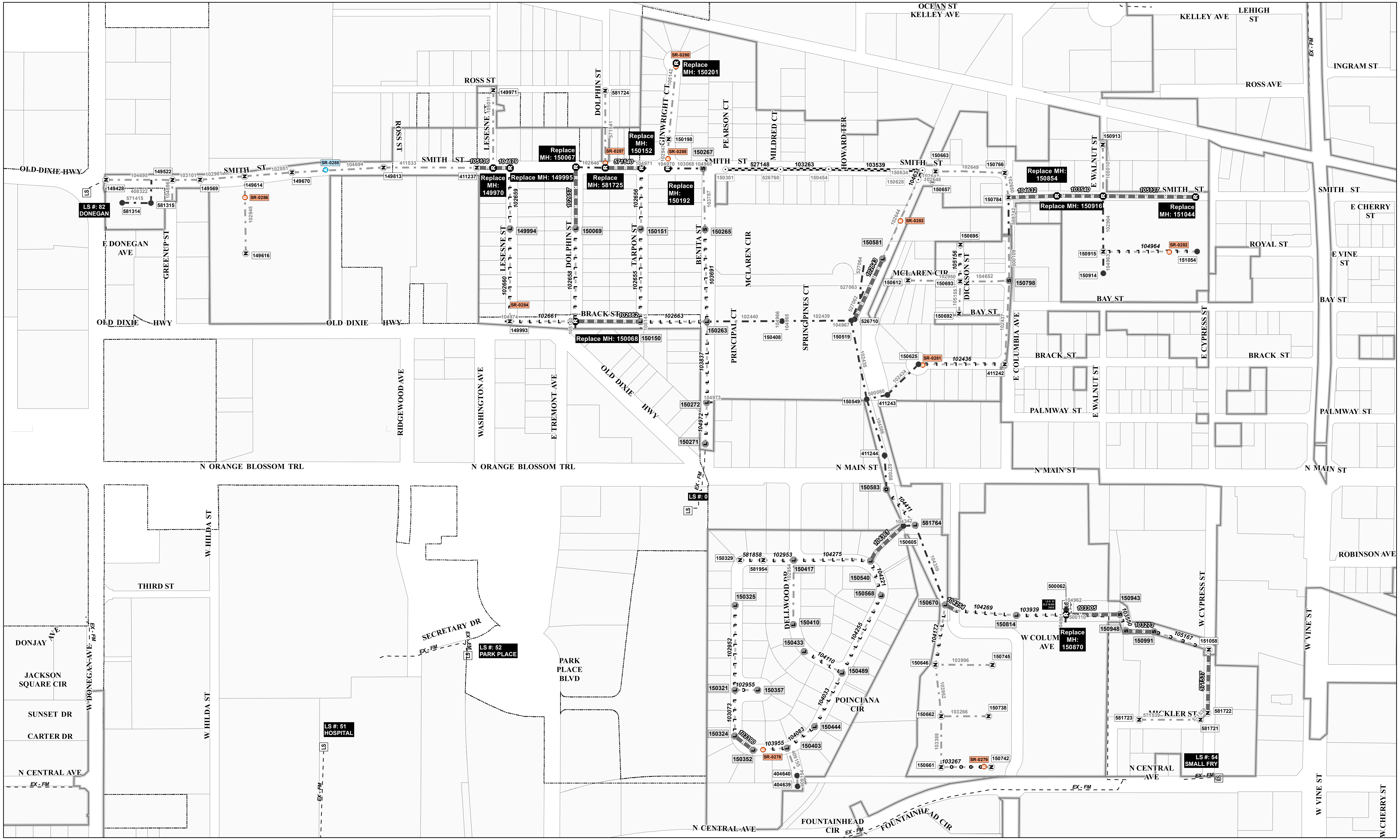

LEGEND

Replace MH: 381453	Replace	153926	Other, Refer to Notes
153926	Line	381453	No Action
153927	Seal and Coat	153927	Asset Not In Scope
		153927	Maintenance Complete

105019	Clean	390552	Other, Refer to Notes
102055	Line	102109	No Action
102054	Replace	102047	Asset Not In Scope
			Maintenance Complete

SR-0113 CIPP Spot Repair
SR-0125 Open Cut Spot Repair

Lift Station Service Area
LS Existing Lift Stations
EX FM Existing Force Main

N

1 inch = 200 feet

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TOHO WATER AUTHORITY
LS # 53 OLD WINN DIXIE
GRAVITY SEWER REHABILITATION

R/R GRAVITY PACKAGE NO 1

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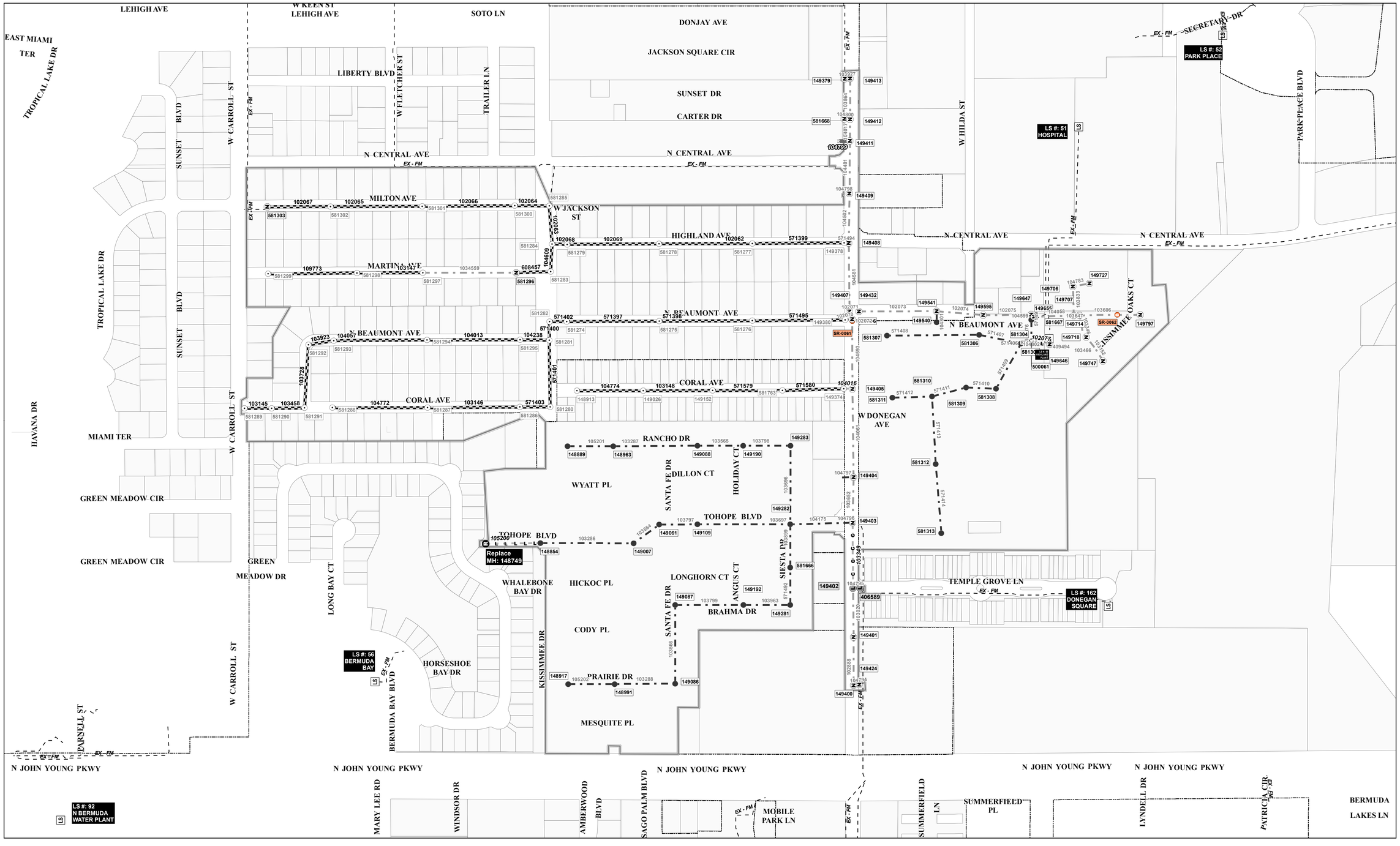

LEGEND

Replace MH: 381453 (R)	Replace	153926 (O)	Other, Refer to Notes	105019	Clean	390552	Other, Refer to Notes
153926 (L)	Line	381453 (N)	No Action	102055	Line	102109	No Action
153927 (S)	Seal and Coat	153927	Asset Not In Scope	102094	Replace	102047	Asset Not In Scope
		153927	Maintenance Complete				Maintenance Complete

SR-0113 (A)	CIPP Spot Repair		Lift Station Service Area
SR-0125 (B)	Open Cut Spot Repair	LS	Existing Lift Stations
		EX FM	Existing Force Main

N

1 inch = 200 feet

Bar Measures 1 inch

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LS # 55 HIGHLAND PLANT
GRAVITY SEWER REHABILITATION

R/R GRAVITY PACKAGE NO 1

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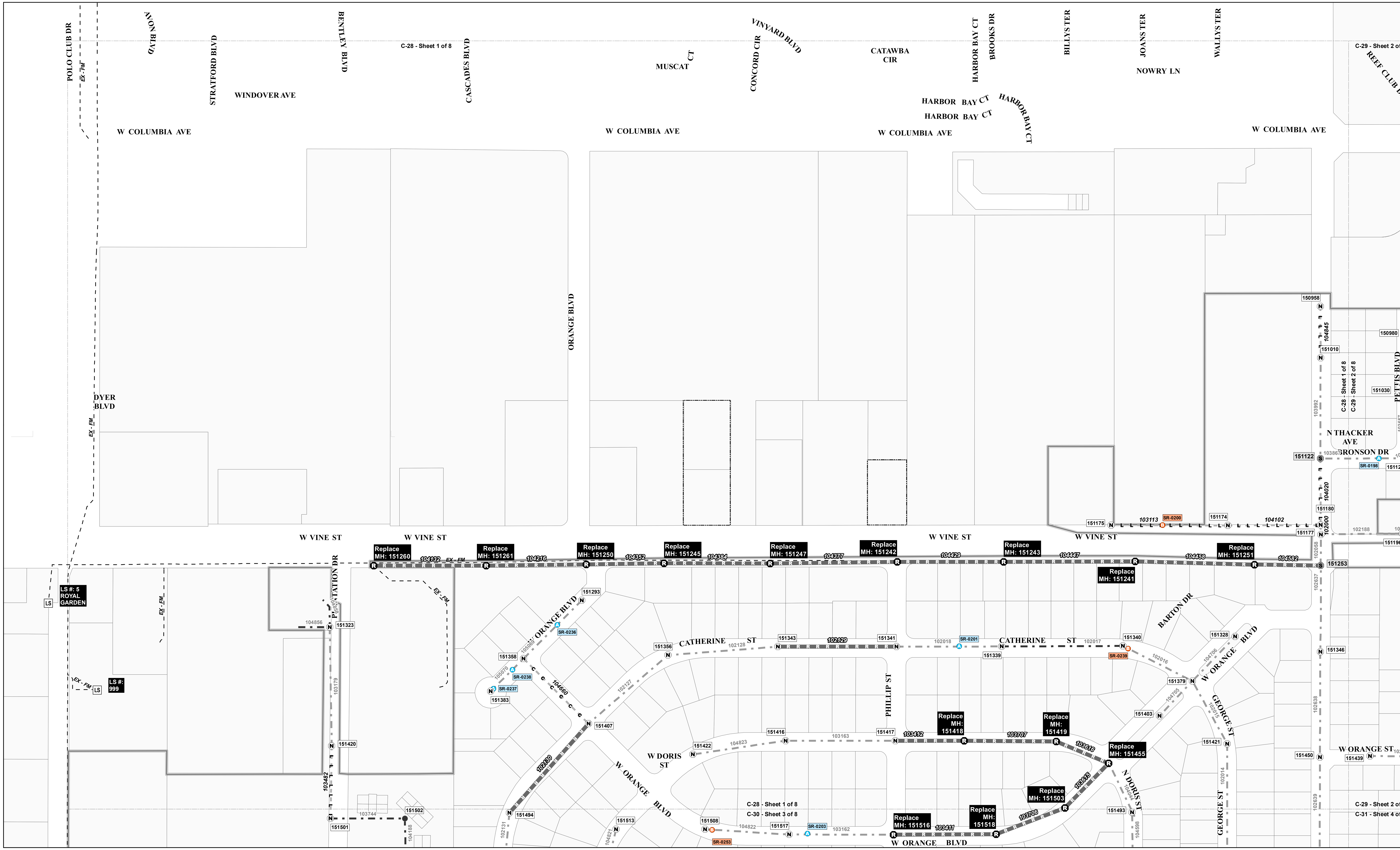

LEGEND

Replace	Other, Refer to Notes	Clean	Other, Refer to Notes
Line	No Action	Line	No Action
Seal and Coat	Asset Not In Scope	Replace	Asset Not In Scope
	Maintenance Complete		Maintenance Complete

- CIPP Spot Repair
- Open Cut Spot Repair
- Lift Station Service Area
- Existing Lift Stations
- Existing Force Main

N

1 inch = 150 feet

Bar Measures 1 inch

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TOHO WATER AUTHORITY
LS # 57 MARTIN ST
GRAVITY SEWER REHABILITATION

R/R GRAVITY PACKAGE NO 1

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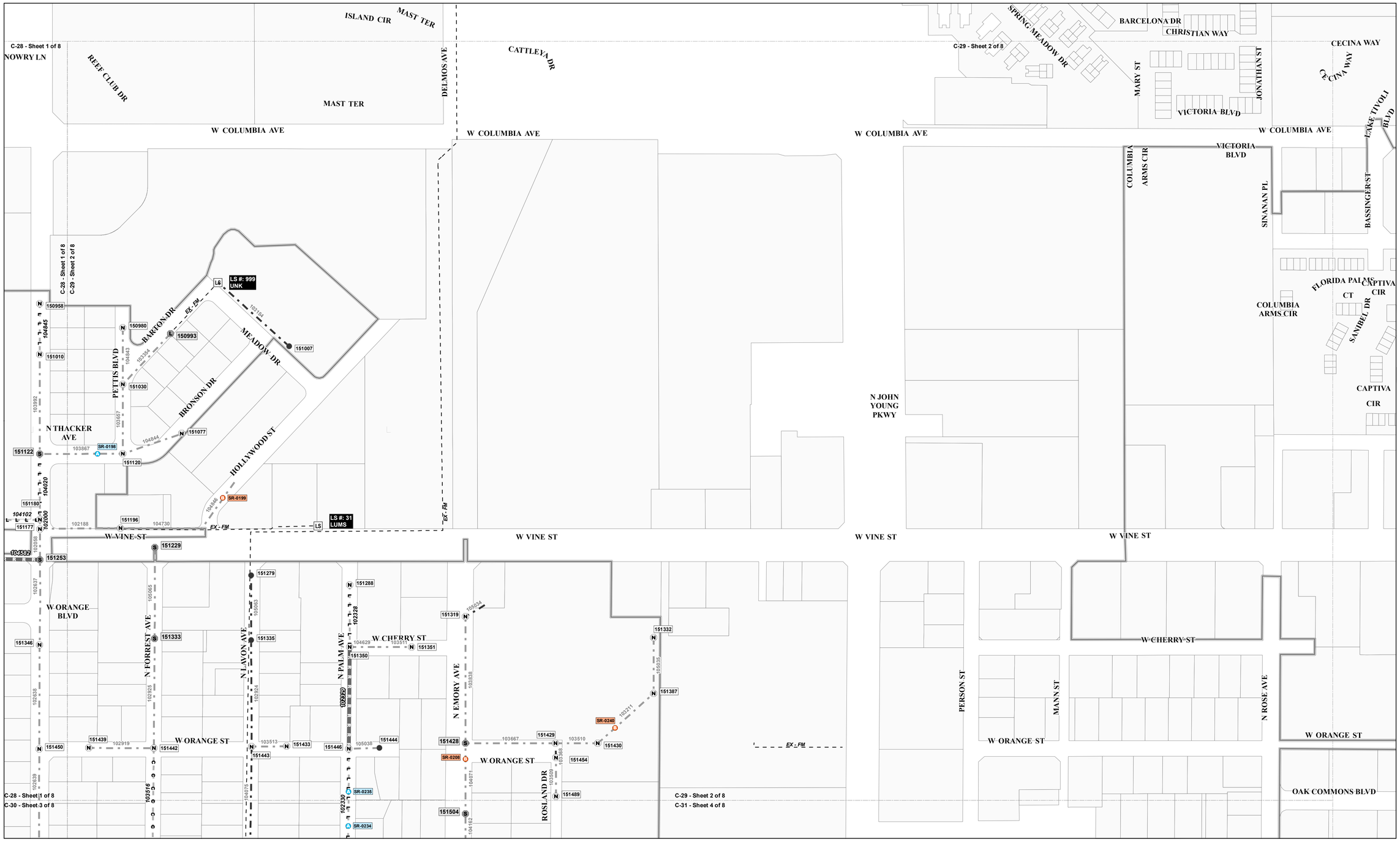

LEGEND

Replace MH: 381453 (R)	Replace	153926 (O)	Other, Refer to Notes	105019	Clean	390552	Other, Refer to Notes
153926 (L)	Line	381453 (N)	No Action	102055	Line	102109	No Action
153927 (S)	Seal and Coat	153927	Asset Not In Scope	102094	Replace	102047	Asset Not In Scope
		153927	Maintenance Complete				Maintenance Complete

SR-0113 (A)	CIPP Spot Repair		Lift Station Service Area
SR-0125 (B)	Open Cut Spot Repair	LS	Existing Lift Stations
		EX FM	Existing Force Main

N

1 inch = 150 feet

Bar Measures 1 inch

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GRAVITY SEWER REHABILITATION

R/R GRAVITY PACKAGE NO 1

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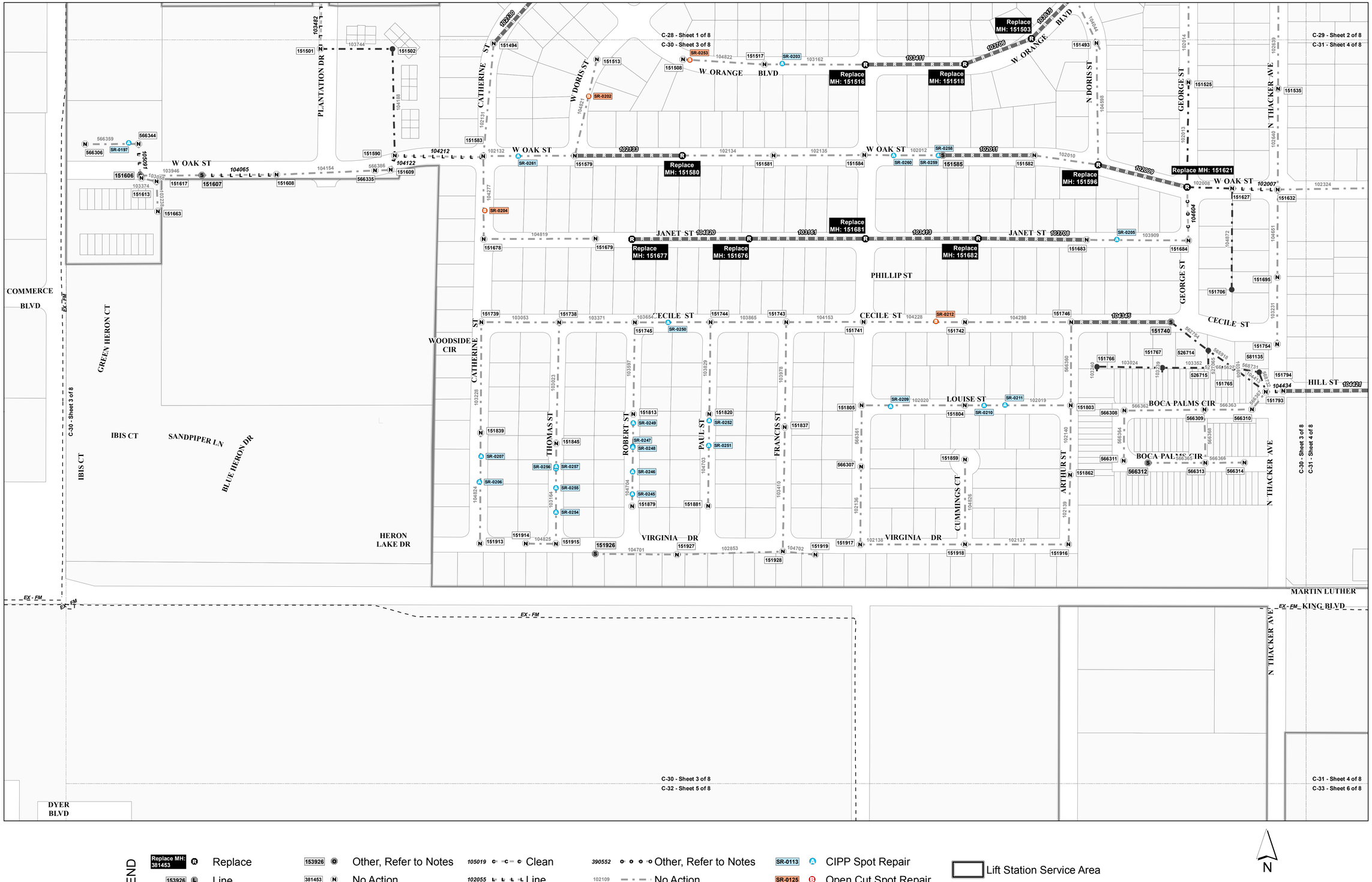

LEGEND

Replace MH: 381453 (R)	Replace	153926 (O)	Other, Refer to Notes	105019	Clean	390552	Other, Refer to Notes
153926 (L)	Line	381453 (N)	No Action	102055	Line	102109	No Action
153927 (S)	Seal and Coat	153927	Asset Not In Scope	102034	Replace	102047	Asset Not In Scope
		153927	Maintenance Complete				Maintenance Complete

SR-0113 (A)	CIPP Spot Repair		Lift Station Service Area
SR-0125 (B)	Open Cut Spot Repair	LS	Existing Lift Stations
		EX FM	Existing Force Main

N

1 inch = 150 feet

Bar Measures 1 inch

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R/R GRAVITY PACKAGE NO 1

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C-29 - Sheet 2 of 8
C-31 - Sheet 4 of 8
C-30 - Sheet 3 of 8
C-31 - Sheet 4 of 8
C-30 - Sheet 3 of 8
C-32 - Sheet 5 of 8
C-31 - Sheet 4 of 8
C-33 - Sheet 6 of 8
C-31 - Sheet 4 of 8

N THACKER AVE
N LAVON AVE
W MAGNOLIA ST
ROSLAND DR
MANN ST
OAK COMMONS BLVD
W OAK ST
EX - FM
N FORREST AVE
Replace MH: 151665
Replace MH: 151715
N PALM AVE
W LAKE ST
N ROSE AVE
PERSON ST
CECILE ST
HILL ST
BOCA PALMS CIR
Replace MH: 151853
Replace MH: 151884
Replace MH: 151889
N EMORY AVE
Replace MH: 151866
N JOHN YOUNG PKWY
HENRIETTA ST
LINCOLN ST
ALMA ST
LEE ST
BOCA PALMS AVE
MARTIN LUTHER KING BLVD
JUNE ST
FLORIDA ST
LS #: 32 FLORIDA AVE
FINLEY AVE
N RANDOLPH AVE
N DILLINGHAM AVE
N CLYDE AVE
KING ST
Replace MH: 404722

LEGEND

Replace MH: 381453	R	Replace	153926	O	Other, Refer to Notes	105019	Clean
153926	L	Line	381453	N	No Action	102055	Line
153927	S	Seal and Coat	153927		Asset Not In Scope	102094	Replace
			153927		Maintenance Complete		

390552	Other, Refer to Notes	SR-0113	A	CIPP Spot Repair
102109	No Action	SR-0125	B	Open Cut Spot Repair
102047	Asset Not In Scope			
	Maintenance Complete			

Lift Station Service Area
LS Existing Lift Stations
EX FM Existing Force Main

N

1 inch = 150 feet

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GRAVITY SEWER REHABILITATION

R/R GRAVITY PACKAGE NO 1

Project No.: 200-08466-16009
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Bar Measures 1 inch

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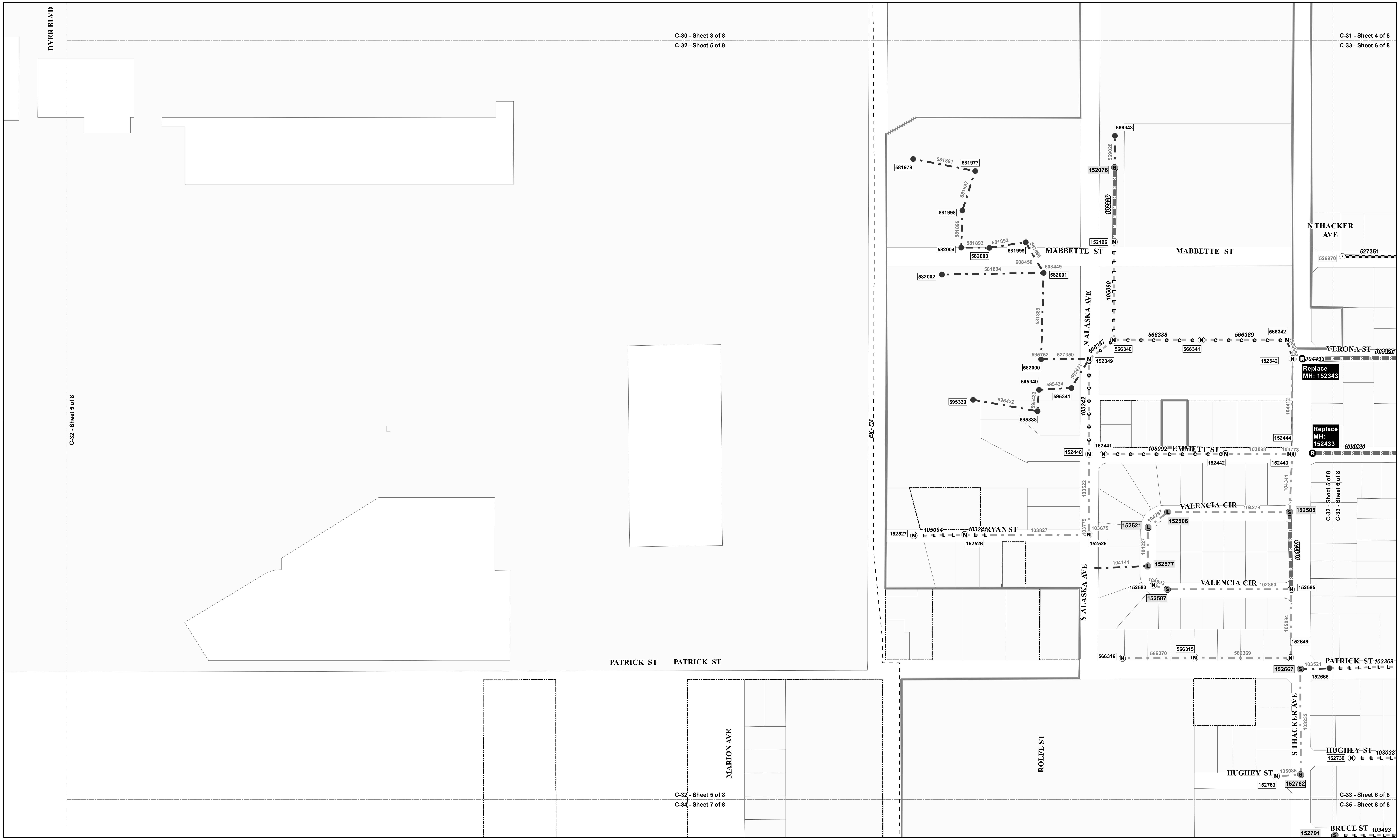

LEGEND

Replace MH: 381453 Ⓡ Replace	153926 ⓞ Other, Refer to Notes	105019 Clean	390552 Other, Refer to Notes
153926 Ⓛ Line	381453 Ⓝ No Action	102055 Line	102109 No Action
153927 Ⓢ Seal and Coat	153927 ● Asset Not In Scope	102054 Replace	102047 Asset Not In Scope
	153927 Maintenance Complete		Maintenance Complete

SR-0113 CIPP Spot Repair
SR-0125 Open Cut Spot Repair

Lift Station Service Area
LS Existing Lift Stations
EX FM Existing Force Main

N

1 inch = 150 feet

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GRAVITY SEWER REHABILITATION

R/R GRAVITY PACKAGE NO 1

Project No.: 200-08466-16009
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Sheet 5 of 8

Bar Measures 1 inch

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LEGEND

Replace MH: 381453 (R)	Replace	153926 (O)	Other, Refer to Notes	105019	Clean	390552	Other, Refer to Notes
153926 (L)	Line	381453 (N)	No Action	102055	Line	102109	No Action
153927 (S)	Seal and Coat	153927	Asset Not In Scope	102034	Replace	102047	Asset Not In Scope
		153927	Maintenance Complete				Maintenance Complete

SR-0113 (A)	CIPP Spot Repair
SR-0125 (B)	Open Cut Spot Repair
	Lift Station Service Area
LS	Existing Lift Stations
EX FM	Existing Force Main

N

1 inch = 150 feet

Bar Measures 1 inch

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GRAVITY SEWER REHABILITATION

R/R GRAVITY PACKAGE NO 1

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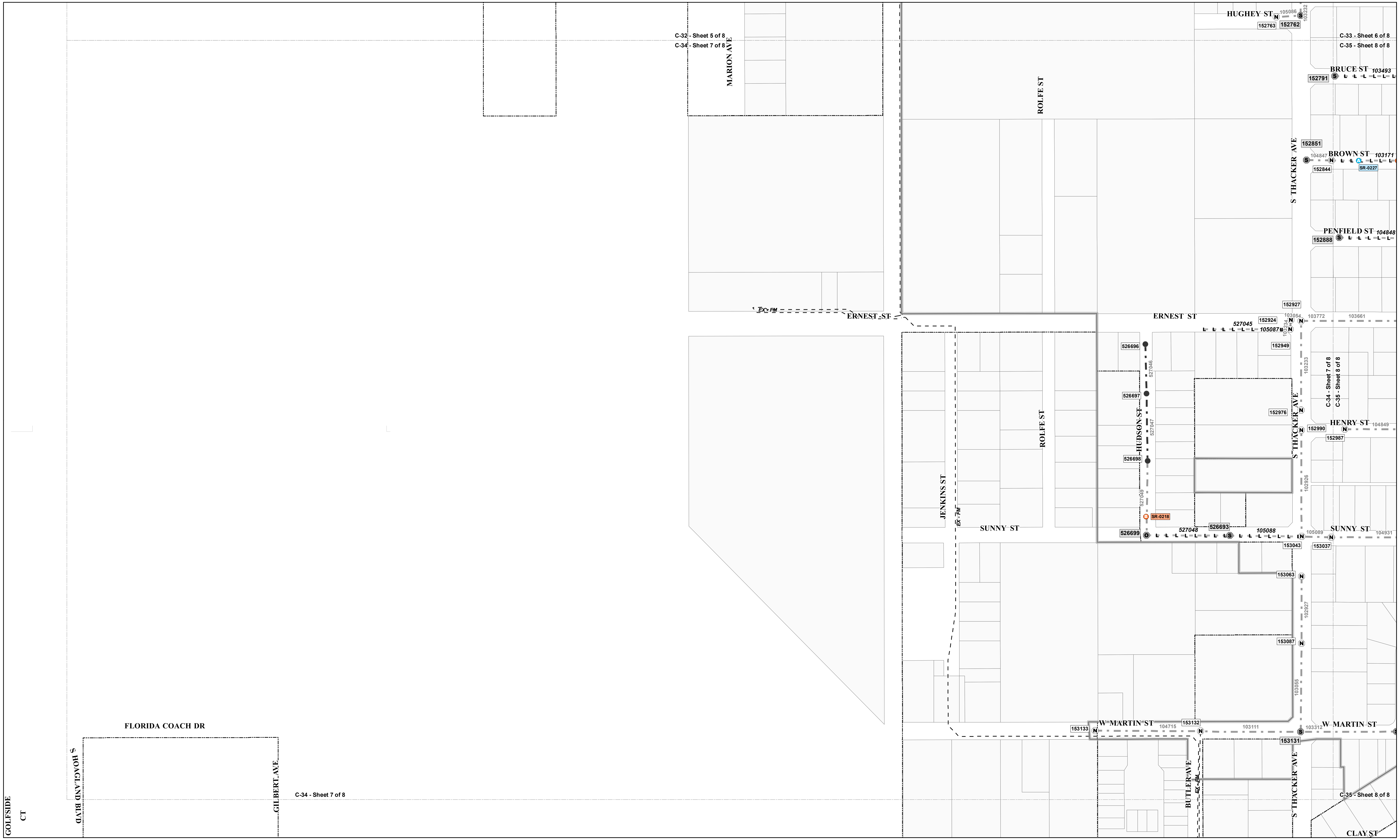

LEGEND

Replace MH: 381453	Replace	153926	Other, Refer to Notes
153926	Line	381453	No Action
153927	Seal and Coat	153927	Asset Not In Scope
		153927	Maintenance Complete

105019	Clean	390552	Other, Refer to Notes
102055	Line	102109	No Action
102054	Replace	102047	Asset Not In Scope
			Maintenance Complete

SR-0113	CIPP Spot Repair
SR-0125	Open Cut Spot Repair

Lift Station Service Area
LS Existing Lift Stations
EX FM Existing Force Main

N

1 inch = 150 feet

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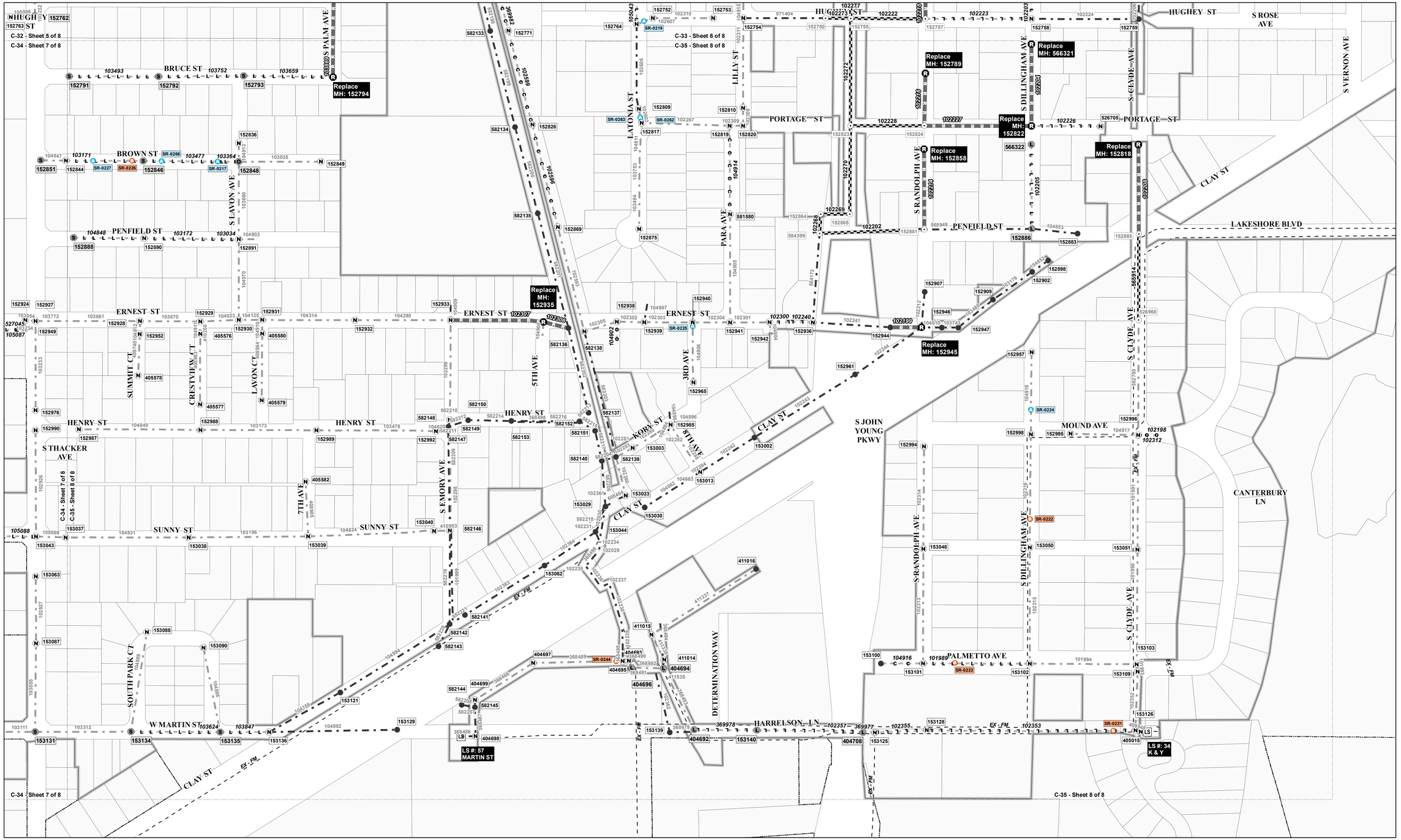

LEGEND

Replace MH: 381453 (R)	Replace	153926 (O)	Other, Refer to Notes	105019	Clean	390552	Other, Refer to Notes
153926 (L)	Line	381453 (N)	No Action	102055	Line	102109	No Action
153927 (S)	Seal and Coat	153927	Asset Not In Scope	102094	Replace	102047	Asset Not In Scope
		153927	Maintenance Complete				Maintenance Complete

SR-0113 (A)	CIPP Spot Repair		Lift Station Service Area
SR-0125 (B)	Open Cut Spot Repair	LS	Existing Lift Stations
		EX FM	Existing Force Main

N

1 inch = 150 feet

Bar Measures 1 inch

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Appendix B:
Defect Recommendation Guide

Appendix B:

TWA Sewer System Inspection Repair Recommendation Guide

Sewers:

When reviewing sewer inspections to make recommendations for review, perform a full review of the pipeline asset. Use the National Association of Sewer Service Companies Pipeline Assessment Certification Program (NASSCO PACP) scoring to understand the severity of defects and to define the approach to each pipeline review. PACP grading is a uniform method of coding common defects observed in sewer pipelines. These defect observations are made in the field and software assigns scoring to the defects, however PACP does not provide any information for what must be done next.

Some utility owners use PACP scoring to directly prioritize which pipelines need to have action taken, in some cases using grade 3 or 4 defects as the cut off and not addressing any of the pipelines that only had Grade 1, 2 or even 3 defects observed. This is not recommended practice, as the investment has already been made in obtaining the inspections, and there may be defects that are missed or under-coded and require repairs. If a Lateral Assessment Certification Program (LACP) inspection was not included at the time, then defects in the lateral will not be coded in a PACP inspection, even though there is a visual observation of each lateral included with each main line inspection. Useful information from manholes, can also be gleaned from the beginning and end of each mainline inspection as well as supporting evidence for different modes of failure that may be occurring in the system.

In order to ensure that the data collected from these inspections is optimized in an efficient manner, use the following as guidance for the level of review effort for each pipeline:

- PACP Defects Grade 1 or 2 – Spot check level of sags, review all tap connections and any material changes where defect scores may not have been coded correctly. Perform upstream and downstream manhole observations in the event that a dedicated Manhole Assessment Certification Program (MACP) inspection was not completed for that node.
- PACP Defect Grade 3 – Spot check grade 3 defects as well as items of potential concern listed above.
- PACP Defects Grade 4 or 5 – Review full sewer inspection. Pay close attention to all joint offsets, sags, deformations, and lateral defects to make sure the correct decision of trenchless vs. open cut solution is made.

Regardless of the PACP defect score, each pipe will be reviewed holistically to ensure that the correct repair strategy has been selected. A realistic sewer repair approach has been taken to only address defects that are posing a structural risk or progressive maintenance risk that can be solved through some capital improvements. Minor defects that do not pose any immediately foreseeable threat will have no action taken.

As staff complete the reviews and assign recommendations, each completed asset will be flagged as ready for review by a senior engineer who will spot review and confirm or adjust each recommendation. This QA/QC approach also looks at each lift station area as a whole to identify common defects and ensure that recommendations are applied consistently and in a feasible and constructible manner.

There are six different recommended actions available in the review tool drop-down menu to use for various defects that coincide with typical sewer rehabilitation and repair work. Each option is listed below with additional explanation and guidance to help in making the appropriate recommendation.

Recommended Action	Defects	
No Action	*No impactful structural defects*	*Non-progressive O&M defects*
	Minor sags (pvc)	

No action is the recommendation when the pipeline is found to have no defects, or the defects observed in the pipe are not posing any risk to the structural or operational status of the pipe. Some examples of low-risk defects that are not cost effective to attempt to repair include minor cracking, sags (< 25%, where flow is visibly passing through the sag with no issues), minor surface damage to pipe walls such as exposed aggregate, and slightly offset joints. Defects that appear to not be progressive such as low-level infiltration staining or miscellaneous attached grease can also be deferred until a later time if the condition is to worsen. In general, it is not cost effective to perform capital repair work to correct the types of defects above if they are not causing harm or posing risk to the operation of the system.

Recommended Action	Defects	
Clean	*Roots*	*Sludge/Debris that blocks the camera*
	Grease attached to walls or crown	

Cleaning is to be recommended in the case where the pipeline is in good structural condition and does not require any repair work, but has enough debris/sludge/roots/grease in the pipe to be causing issues with the flow in the main. Pipeline with the above observations that also require structural repair will typically be cleaned as part of preparation of the structural repair work, so this would not need a redundant recommendation if the pipe were to be lined or have a spot repair.

Cleaning is also recommended when the obstacles to be cleaned from the line appear to require greater effort to remove from the line than standard sewer jetting and flushing. This includes heavy deposits of sludge that stop the camera tractor, roots, mineral deposits or attached grease occupying 30% and greater of the pipe cross section and may require additional means of removal including chemical or mechanical methods. The associated cleaning pay item will then be specified to include all forms of removal and be bid separately from standard sewer cleaning work. Below are example of pipe s that should be cleaned:

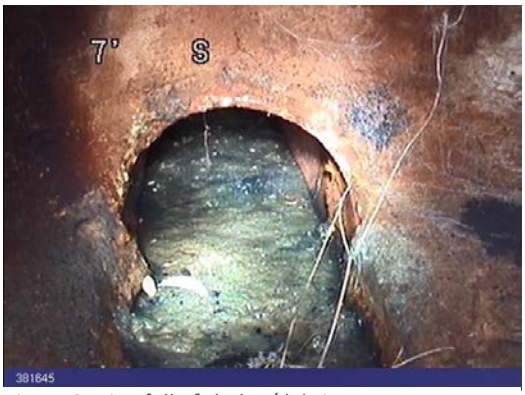

Figure 2- Pipe full of sludge/debris

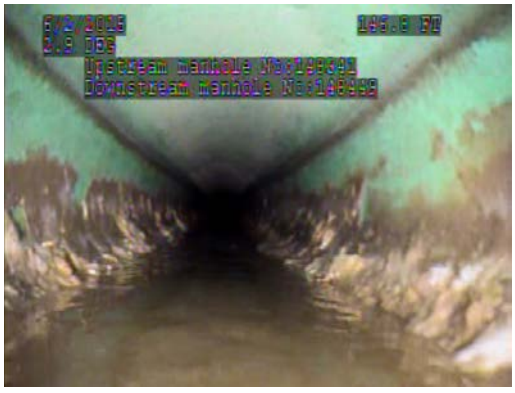
Figure 1 - Attached grease

Recommended Action	Defects	
Spot Repair	*Offset joints*	*Joint issues/ holes (spot liners)*
	Cracked laterals at pipe (Lateral liners)	*Separated laterals at pipe(cannot be lined)*
	Collapsed rigid pipe	*Deformed flexible pipe*

Spot repair recommendations are made by placing a spot repair icon along the given gravity main, and include information on the type of problem, the approximate length of the problem and the distance of the repair from the upstream or downstream manhole. In the comments section, the type of spot repair, either open cut or trenchless should also be noted for use in developing concise construction documents during design. Spot repairs may be recommended under the following circumstances below.

The majority of the gravity main is in good structural condition and there is an isolated defect such as a offset/failed joint or service tap, short unacceptable sags, obstacles penetrating through a pipe segment such as a bored gas main, failed flexible connectors, or any other short (preferably 20 feet long or less) continuous defects. In these instances, the overall pipe is found to be in good enough condition to where the overall line integrity after performing the repair will be satisfactory. See below for examples of some defects that may only require a spot repair to fix:

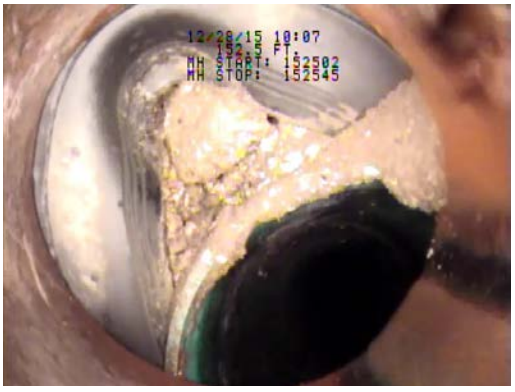

Figure 4- Offset joint

Figure 3 – Vertical Pipe penetration

The second circumstance is where the overall gravity main is in poor condition and may be a suitable candidate for lining, however there are certain defects that may prevent successful lining (offset joints, collapsing pipe, deformed pipe, protruding laterals or pipe penetrations, etc.) or certain defects that cannot be fixed through lining alone (pipe sags, services separated from the main, etc.). When these observations are made, a spot repair must be associated with the pipe that is recommended to be lined, and a comment added to perform spot repair prior to lining. Below are examples of defects that mainline CIPP lining cannot fix and may require a spot repair.

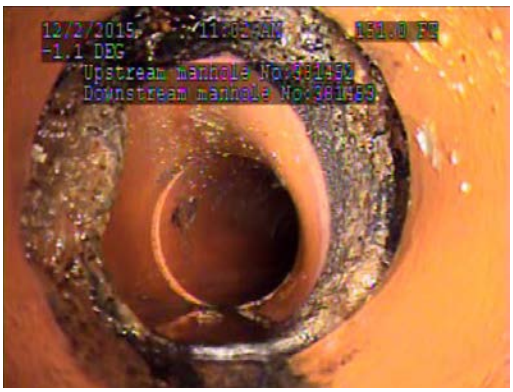

Figure 6- Offset lateral connection

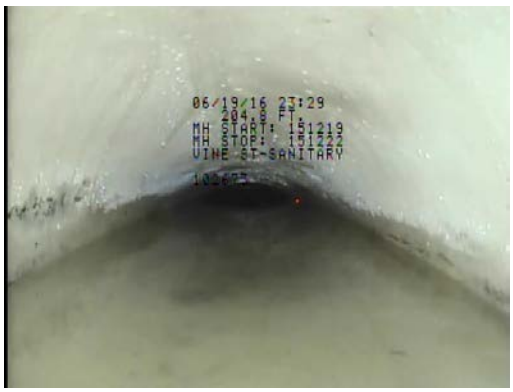

Figure 5 – Pipe sag

The connections to the existing pipeline on either side of a spot repair are prone to settlement due to the nature of the repair process and difficulty to achieve optimal compaction under sometime suboptimal conditions. To address issues with settlement at the joints, the pipe joins should be completed with rigid connections, and the entire length of the spot repair pipe envelope be backfilled with stone to mitigate compaction concerns. Rigid connectors are preferred for spot repairs on pipes to be lined as well, since most settlement at a flexible connection will occur during or immediately after the backfill process and likely before the host pipe could be lined which will provide an additional safeguard from the potential joint shear or offset in the future.

Trenchless spot repairs are also included under this recommendation category. Mainline gravity main trenchless spot repairs would consist of a short segmental pipe liner, approximately 3 to 5 feet long (longer in some cases) and be used to addressed specific isolated defects such as joints with significant I/I, individual separated or broken pipe joints, pipe segments with holes, short segments of corroded DIP pipe, etc. If there is a problem at a service connection, either a sewer tap or wye connection where the integrity of either the mainline pipe or the lateral pipe is in question, then a lateral liner is recommended. It is quite common to have the main fracture due to the installation of the tap or from years of strain a tap may place on the main, leading to infiltration, debris, or root problems that can be solved through the installation of a lateral liner. Additional care must be taken when assessing a defective lateral for potential lining, as lateral liners can be difficult to install on connections that have any type of offset which may prevent the equipment from properly installing the liner. An improperly installed lateral liner may result in flow backups. See below for examples of defects that could be repaired with segmental or lateral liners.

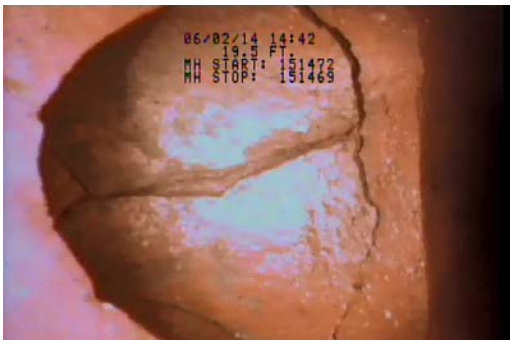

Figure 8- Fractured, intact lateral

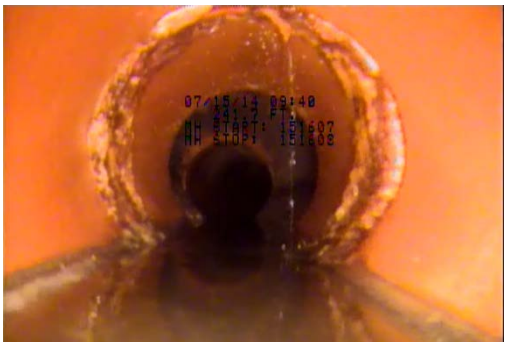
Figure 7 – Lone joint with running infiltration

In general, a pipe should have no more than one or two spot repairs, particularly if the pipe is also noted to be lined. There is the possibility that even though the individual defects could be addressed through some type of open cut or trenchless means or combination thereof, the final product may not be great quality, or cost effective versus the alternative of a full open cut replacement.

Recommended Action	Defects	
Line	*Cracking/fracturing/broken*	*Minor sags VCP (min hydraulic impact)*
	Separating joints	*Corroded DIP & Concrete Pipe*
	Continuous roots/joint deposits	

Cured-in-place-pipe (CIPP) lining is the most common form of sewer rehabilitation for gravity main collection systems. It is an ideal product to complete a full structural repair of a full reach of sewer with no, or minimal excavation. While typically used to counter against pipe with cracking/fracturing and other structural issues, it is also effective in extending the life of a gravity main that is exhibiting failing pipe joints.

Concrete pipe was used in the past, however it is not an ideal material for sanitary sewers as the pipe walls can be susceptible to hydrogen sulfide corrosion

Vitrified clay pipe is a common pipe material found in the system, and is very prone to joint failure as the mains age, in particular if there is a high groundwater table. When joints begin to leak, the water brings fine soil particles into the sewer, eventually undermining the support around a pipe that can lead to greater failure, so it is wise to address pipelines that have poor joints that are leaking and beginning to offset before additional damage is done. Below are some examples of pipe defects that would warrant lining.

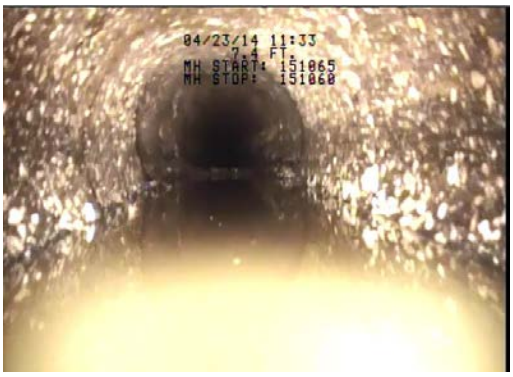

Figure 10- Concrete pipe wall corrosion

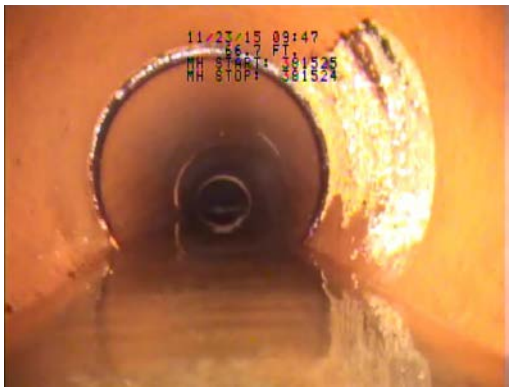

Figure 9 – VCP cracking

Action	Defects	
Replace	*Collapsed or deformed*	*Pipes with multiple spot repairs*
	Sagged pipes	

Trenchless repairs are preferred when feasible in order to minimize disruption to the surrounding area and adjacent utilities during the repair. There is a limit to what can be done using trenchless means and methods. For collector sewers, CIPP lining is the primary means of trenchless structural rehabilitation, but if that host pipe has any of the following specific defects, then CIPP lining is not a practical solution. CIPP lining relies on a host pipe as part of the installation process, meaning that pipes that are collapsed,

or no longer round could prevent a cured liner from working as it was designed. Deformed pipe may prevent a CIPP Lier from reaching its design strength and result in premature failure.

In many cases, an isolated instance of broken pipe can be replaced prior to lining, but where the issue is either continuous or found in multiple locations, it may not be cost effective to make open cut repairs, and then to line the main. This is common where there are service lateral failures that will not be treated through CIPP lining of the main. Should the service laterals also require repair through either CIPP lateral lining or open cut replacement, those additional costs quickly escalate and exceed the cost to perform a full pipeline replacement. Even if the costs do not exceed the additional work required to make the repair, such as pavement replacement, it would typically result in a lower quality final product than if the pipe were replaced. If the location allows, there is less risk in replacing a main in its entirety rather than developing complex phased rehabilitations.

Replacement is also the only true way to repair sagged pipes. A pipe with a sag indicates that the pipe was either installed improperly, or eventually settled due to other conditions. Sags are identified during a pipe inspection through changes in the observed water level in the pipe. Sags can be an indication of more severe defects that may not be visible due to the higher water level, such as separated joints, which could be worsened as more pipe support material is pulled into the pipe. Sags can also lead maintenance defects related to grease becoming attached to the crown of a pipe that will continue to restrict the pipe capacity. Sags also prevent the owner from completing an inspection, leaving too many unknown conditions to make a justifiable recommendation for repair. The table below relates the guidance provided by NASSCO for rating sags.

NASSCO Defect Grade	Observed Water Level
2	≤30%
3	>30% to ≤50%
4	>50% to ≤75%
5	>75%

The table shows that NASSCO would show that a pipe with a 50% water level could receive a score of 3 or below, meaning if the mains were screened for defects, that some significant problems could be missed. Our approach involves reviewing all sags and for existing mains, apply the following additional screening.

A. If there is enough positive grade across the sag to keep water flowing freely through the main, and there are no visible defects at the pipe joints, then no action needs to be taken.
    - If there are structural issues along the pipe above, then a CIPP liner can be installed to correct the structural deficiencies.
B. Where the sag holds standing water or the camera is submerged during the inspection going into a sag, the sag should be reviewed for repair by completing an inspection from both ends and gathering as much information about the sag as possible.
    - These sags should be repaired to the limits of existing pipe as needed to eliminate the sag, this may require the replacement of a manhole in some cases.
    - These sags should be repaired prior to any additional sewer rehab such as CIPP lining.

- Where the length of the sag is greater than 33% of the overall pipe length or there are 3 or more isolated sags to repair, consider full length replacement.

Below are some screenshots of defects that eventually resulted in recommendations for pipe replacement.

Figure 12- Full pipe sag

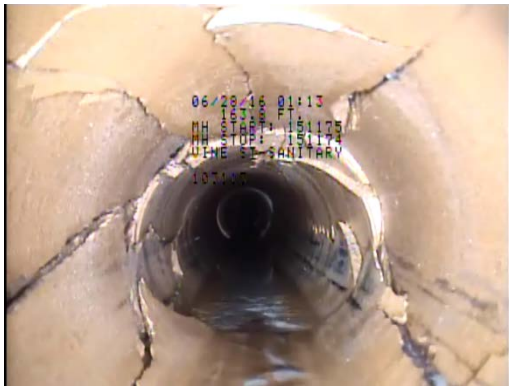

Figure 11 – VCP broken unable to line

Action	Defects	
Other, Describe in Comments	*Extraordinary defects*	*Repairs with sequencing issues*
	Mult. Repairs on single pipe	*Lined pipes with lateral defects at Pipe*

Not every observed defect will have a simple solution, as there may be unique conditions or circumstances present that place the recommended repair outside of one of the typical recommendation categories. One example is where the existing main and all service lateral connections have been CIPP lined in the past, and there are continuous observations of defects at the service lateral liners and liner interface. While this may not be a definitive defect, or perhaps a peculiar construction feature of the liner, the potential repair work would not fall under a clear classification. Some common simple repairs for which there is no clear category includes CIPP lining observations (under or over-cut laterals, liner bulges and wrinkles, delaminating cement mortar lining from ductile iron pipe, etc.)

"Other" was also assigned in cases where the potential repair recommendation may not be the only, or most effective recommendation, For example, a sewer may have been previously lined, and had several sags before lining that are now full of sludge and holding up flow. While one solution may be to replace the sewer to correct the grade problems and address the underlying structural issues at once, the pipe may just need a full cleaning to restore typical operating conditions. Conversely, a pipe that shows signs of surcharging and attached grease may require additional steps above cleaning to prevent the issue from recurring such as replacing the sewer main with a larger pipe to improve capacity. It is difficult to make these types of decision using only the observations from the sewer inspection, since that is only a snapshot of the current conditions. It is best practice to only make a recommendation on what is observed and to not make any inference without additional information. By setting these recommendations to "Other" they are essentially flagged for further review during QA/QC. If after QA/QC there is still uncertainty for the proposed recommendation, the specific defects will be reviewed with the Owner to finalize the rehabilitation strategy.

There are also instances where in order to make the pipe repair, specific repair sequencing must be done in order to be successful, and needs to be treated separately from standard repair work. This may include pipes that need to be lined, but have a segment of metal (CI or DIP) sewer that has become scaled over requires removal prior to pipe lining. While the overall pipe recommendation is to CIPP line the main, the work to remove the scale could be outside the scope of standard pipe lining preparation work or cause the contractor to require different preparation equipment and materials and change the price for the work. Other unique sequencing issues may be in relation to manhole replacement, or groundwater issues in conjunction with a pipe or structure repair.

Below are some snapshots of defects that would fall under the “Other” category.

Below are some snapshots of defects that would fall under the “Other” category.

Figure 14- Cement lining delamination in DIP

Figure 13 – Rust and scale in old iron pipe

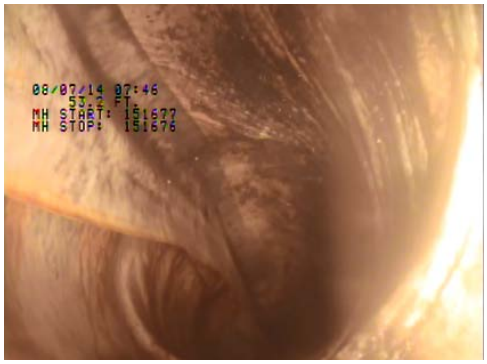

Figure 16- Potentially defective lateral liner

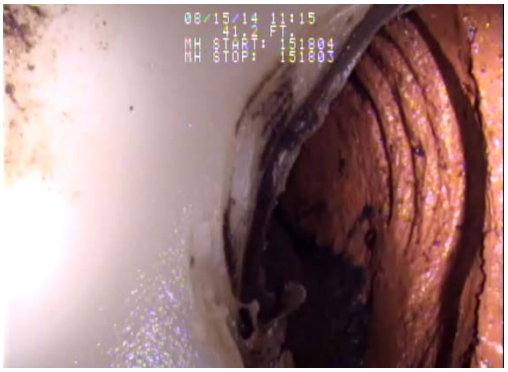

Figure 15 – Undercut CIPP lateral opening

Manholes:

Manhole recommendations are to be made directly from the observations documented during the NASSCO Manhole Assessment Certification Program (MACP) manhole inspections that were collected by TWA. Not every manhole had a unique inspection report. Despite not having dedicated inspection videos for all of the manholes, many of these structures were evaluated based on the footage of the manhole being panned by the sewer televising camera at the upstream and downstream end of the PACP sewer inspections. When the sewer inspection provided no useful footage, the manhole was noted as not having an inspection available.

Manhole repair categories are very similar to those established for the sewer repairs and are further explained below:

Action	Defects	
No Action	*No impactful structural defects*	*I/I staining*

When manholes are found to be in good condition with no structural or maintenance issues, it is not really cost effective to perform any repairs. There could be signs of defects inside the manhole, but so long as there is no defect observed with the clear potential to impact the structural or operational integrity of the structure, then no recommendation will be made. Precast or brick manholes that show very light signs of I/I or just staining should not have any recommendation for repairs.

Action	Defects	
Seal and Coat	*No impactful structural defects*	*Active I/I*
	Chimney defects	*Minor corrosion*

Manholes that show signs of active infiltration, but have no significant structural issues would be sealed and coated for repairs. This category would provide a solution to remedy any typical maintenance defect found prevalent in manholes with high groundwater tables including infiltration, failing pipe connection seals, root intrusions and minor precast concrete wall surface corrosion or minor brick manhole wall mortar loss. These manholes will be sealed of all leaks and then recoated with a manhole liner with a product like Spectrashield (see photo below) or similar.

Many manholes in the inspected areas had already been rehabilitated using products such as chimney seals and in some cases liners. Manholes that had already received some repairs, but were still being overwhelmed by I/I or had failing liners were assigned to be sealed and coated.

Defective manhole chimneys are included to be covered under this recommendation. The products available for use in sealing manhole chimneys is consistent with the materials placed on the manhole walls. Where there are broken adjustment blocks and rings beyond the repair of patching, then the frame and cover of the manhole will be reset during construction prior to the trenchless coating to ensure full coverage of the end product. The resetting of the frame and cover will be determined during final design.

See below for some snapshots of manholes that will be sealed and coated.

Figure 18- Brick MH, minor missing mortar

Figure 17 – Failing chimney seal.

Figure 20- Minor concrete wall corrosion

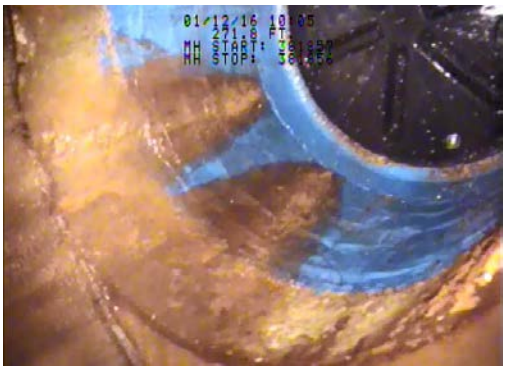

Figure 19 – Leaking chimney seal

Action	Defects	
Line	*Structural defects below chimney*	*Heavy I/I*
	Brick walls mortar joints compromised	*Heavy concrete wall corrosion*
	Pipe penetration issues	

When a brick or precast manhole shows signs of structural degradation and either no or only trenchless work to be done on the gravity main, manholes were recommended to be lined. In most cases these are deeper manholes along larger diameter sewers that have been subjected to H2S degradation of the concrete walls and mortar joints. Other defects that warranted a structural manhole liner included structural problems around pipe penetrations including issues at the flow channel. When extreme I/I conditions were observed and appeared to be too intense to repair through sealing and coating, a liner was recommended. See the snapshots below for examples of manhole that require structural lining.

Figure 22- Excessive concrete manhole wall corrosion

Figure 21 – Corroded manhole walls and lid.

Figure 24- Fractured structure wall

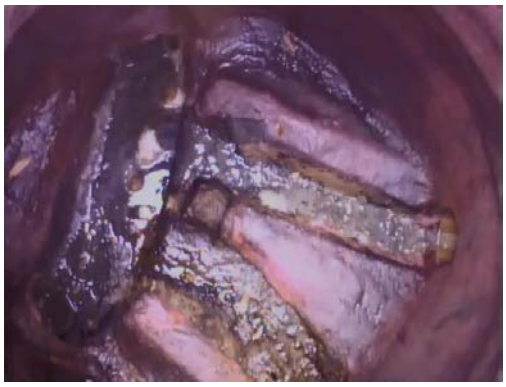

Figure 23 – Manhole with Spectrashield liner

Action	Defects	
Replace	*Settled structures*	*Structures replaced w/ pipe replacements*

Manhole replacement was typically driven by sewer replacement work. Between the structural and non-structural lining products that are recommended for use, there were very few circumstances observed that would require the replacement of an existing manhole unless the adjacent pipe is being replaced. Some manhole replacements were recommended to assist in adjacent pipe repairs where the existing manhole and pipe had settled causing the structure to hold water and various problems in the pipes.

Manhole replacement was also the recommendation where the sewer CCTV inspection revealed that the existing upstream manhole was actually just a dead end pipe. Manholes are needed at both ends of a gravity main to properly maintain the sewer, and access to both ends of the pipe is mandatory to perform the majority of sewer rehabilitation work.

Action	Defects	
Other, Describe in Comments	*Flow channel / bench issues*	*Offset frame and cover*
Spot Repair	*Interior drop connection defects*	*Frame and cover defects*

MACP inspections are set up to focus on the different components of a manhole, including the frame and cover, chimney, walls, bench, etc. This is partly to assist in organizing information to be collected in each manhole during an inspection, it also shows that manholes can have isolated defects that can be targeted for repair through specific work items without requiring a full manhole lining or replacement.

For example, a manhole with a broken or heavily corroded frame or cover, just that element of the manhole could be replaced. There were also isolated defects in manhole regarding broken interior drop connections, fractured and inadequate manhole benches or failed pipe bulkheads, all of which can be repaired trenchlessly from inside the manhole.

There were a handful of “Other” observations that included some potential defects that may need review with the Owner to determine if repairs are necessary. Some of the observations may not be true defects and just the results of previous construction efforts, things such as grout tubes left in place that have no real bearing on the structural or operational performance of the manhole.

Appendix C:
Opinions of Probable Cost

TWA Sanitary Sewer Gravity Main R&R Summary								
Lift Station Area	**GS Rehab Cost**	**GS Replace Cost**	**Water Main Replace Cost**	**Total Cost**	**Rehab Construction Cost***	**Replace Construction Cost***	**Water Main Construction Cost***	**Total Construction Cost***
LS # 14 SAN REMO EAST	$413,300.00	$251,200.00	$69,100.00	$733,600.00	$545,600.00	$373,100.00	$102,700.00	$1,021,400.00
LS # 15 SAN REMO WEST	$327,000.00	$123,700.00	$60,400.00	$511,100.00	$431,700.00	$183,700.00	$89,700.00	$705,100.00
LS # 41 TROPHY LANE	$377,400.00	$5,400.00	$0.00	$382,800.00	$498,200.00	$8,100.00	$0.00	$506,300.00
LS # 42 COUNTRY CLUB ROAD	$580,600.00	$68,600.00	$20,300.00	$669,500.00	$766,400.00	$101,900.00	$30,200.00	$898,500.00
LS # 43 BOGIE	$353,000.00	$179,200.00	$72,800.00	$605,000.00	$466,000.00	$266,200.00	$108,200.00	$840,400.00
LS # 44 SCORE LANE	$288,800.00	$0.00	$0.00	$288,800.00	$381,300.00	$0.00	$0.00	$381,300.00
LS # 45 HAINES CITY ROAD	$629,200.00	$0.00	$0.00	$629,200.00	$830,600.00	$0.00	$0.00	$830,600.00
LS # 46 COYOTE ROAD	$187,500.00	$98,200.00	$0.00	$285,700.00	$247,500.00	$145,900.00	$0.00	$393,400.00
LS # 47 TIGER ROAD	$588,200.00	$313,900.00	$114,800.00	$1,016,900.00	$776,500.00	$466,200.00	$170,500.00	$1,413,200.00
LS # 54 NORTH FALCON	$205,100.00	$47,800.00	$38,300.00	$291,200.00	$270,800.00	$71,000.00	$56,900.00	$398,700.00
LS # 55 SOUTH FALCON	$59,800.00	$0.00	$0.00	$59,800.00	$79,000.00	$0.00	$0.00	$79,000.00
LS # 101 PINE ISLAND	$20,000.00	$0.00	$0.00	$20,000.00	$26,400.00	$0.00	$0.00	$26,400.00
LS # 102 ADMIRAL CT	$18,500.00	$0.00	$0.00	$18,500.00	$24,500.00	$0.00	$0.00	$24,500.00
LS # 33 OSCEOLA PARK	$235,700.00	$91,000.00	$0.00	$326,700.00	$311,200.00	$135,200.00	$0.00	$446,400.00
LS # 34 K & Y	$7,600.00	$0.00	$0.00	$7,600.00	$10,100.00	$0.00	$0.00	$10,100.00
LS # 35 LAKE FRONT	$1,526,000.00	$3,757,400.00	$935,500.00	$6,218,900.00	$2,014,400.00	$5,579,800.00	$1,389,300.00	$8,983,500.00
LS # 36 NEPTUNE POINT	$112,100.00	$259,000.00	$80,100.00	$451,200.00	$148,000.00	$384,700.00	$119,000.00	$651,700.00
LS # 45 JOHNSON PK	$204,200.00	$140,700.00	$38,100.00	$383,000.00	$269,600.00	$209,000.00	$56,600.00	$535,200.00
LS # 53 OLD WINN DIXIE	$597,100.00	$595,300.00	$65,400.00	$1,257,800.00	$788,200.00	$884,100.00	$97,200.00	$1,769,500.00
LS # 55 HIGHLAND PLANT	$60,100.00	$14,900.00	$0.00	$75,000.00	$79,400.00	$22,200.00	$0.00	$101,600.00
LS # 57 MARTIN ST	$1,310,800.00	$3,858,800.00	$762,100.00	$5,931,700.00	$1,730,300.00	$5,730,400.00	$1,131,800.00	$8,592,500.00
Sub-Total	$8,102,000.00	$9,805,100.00	$2,256,900.00	**$20,164,000.00**	$10,696,000.00	$14,562,000.00	$3,352,000.00	**$28,610,000.00**

* Construction cost includes 10% mobilization and a contingency of 35% for replacement projects and 20% for rehabilitation projects.